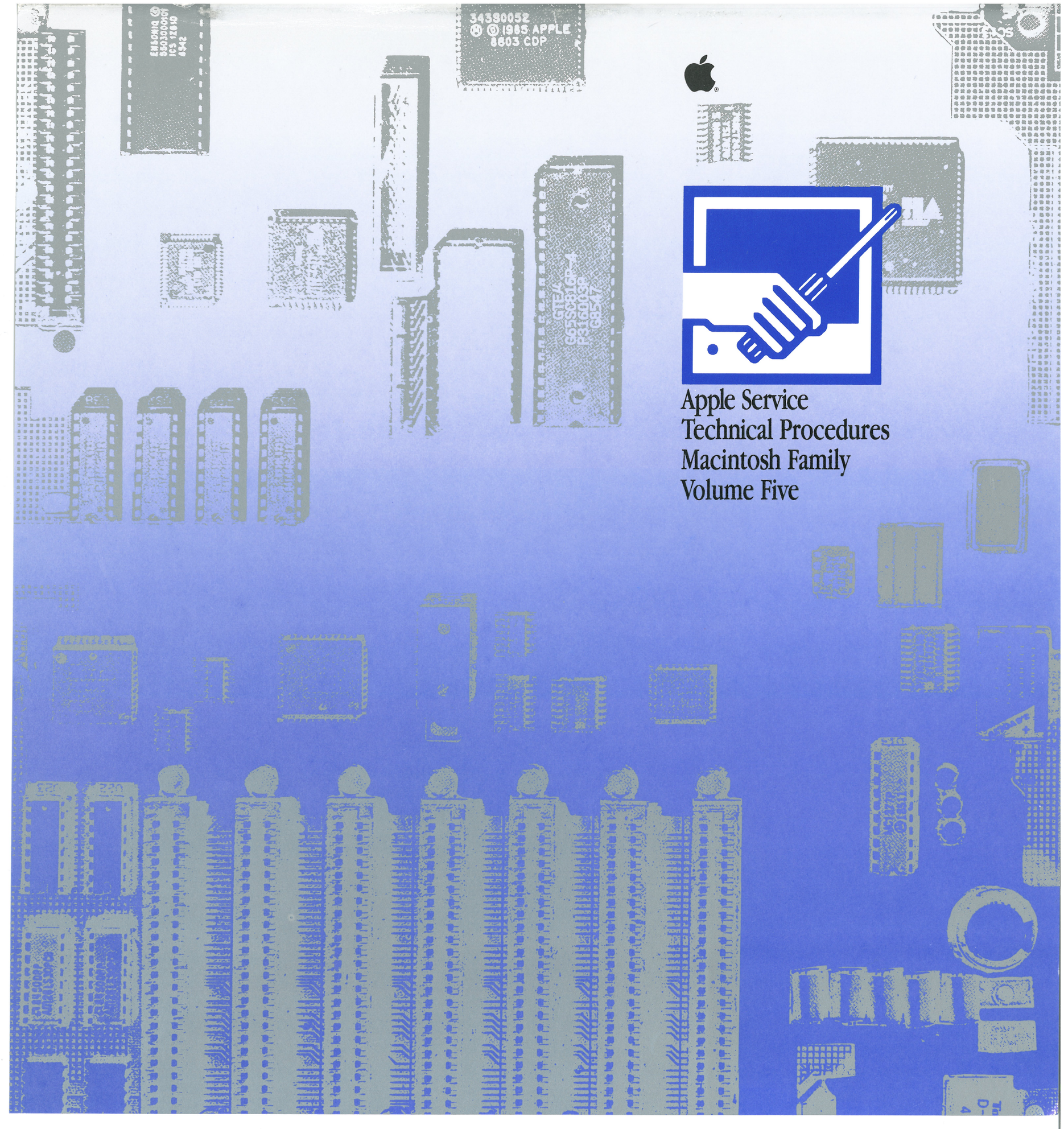

Apple Service Technical Procedures Macintosh Family Volume Five

Apple Service Technical Procedures Macintosh Family

Volume Five

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Apple Technical Procedures

Macintosh Family
Volume Five

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CAUTION: *It is important to read and follow the procedures very carefully wherever this caution symbol appears.*

❑ PRODUCT DESCRIPTION

The Macintosh® Portable computer is a mobile version of the Macintosh computer. This product is designed for portability through the use of a built-in rechargeable lead-acid battery. This battery can provide power for the computer and its options for up to ten hours. The actual time will vary depending on the combination of options installed, usage of these options, and the use of a number of software-controllable power management features.

The architecture of the Macintosh Portable is based on the Macintosh SE and uses many of the same components. Software compatibility with other members of the Macintosh family is maintained.

Features

Figure 1. The original Macintosh Portable has the following features:

- 16-MHz 68HC000 low-power CMOS microprocessor
- 1 MB of static RAM, expandable to 9 MB
- 256K of ROM, expandable to 4 MB
- 640 x 400 reflective, active-matrix flat-panel display
- FDHD™ SuperDrive™ 1.4 MB floppy disk drive
- 96-pin internal processor-dependent expansion slot
- Operates for 6-12 hours from internal, rechargeable battery
- Apple standard keyboard, trackball, and low-power mouse
- Ambidextrous input devices
- External Apple Desktop Bus™, dual RS-422 serial, video, SCSI, floppy disk drive interfaces
- Stereo audio connector
- Internal expansion slots for optional 300/1200/2400 bps modem, RAM card, and ROM card
- Optional 40-MB SCSI hard drive, numeric keypad, and battery recharger

The new Macintosh Portable has the following additional features:

- Backlit display
- 1 MB, 2 MB, or 4 MB (depending on model) of pseudostatic RAM, expandable to 8 MB
- 40-MB SCSI hard drive
- Operates for 3-6 hours from internal, rechargeable battery

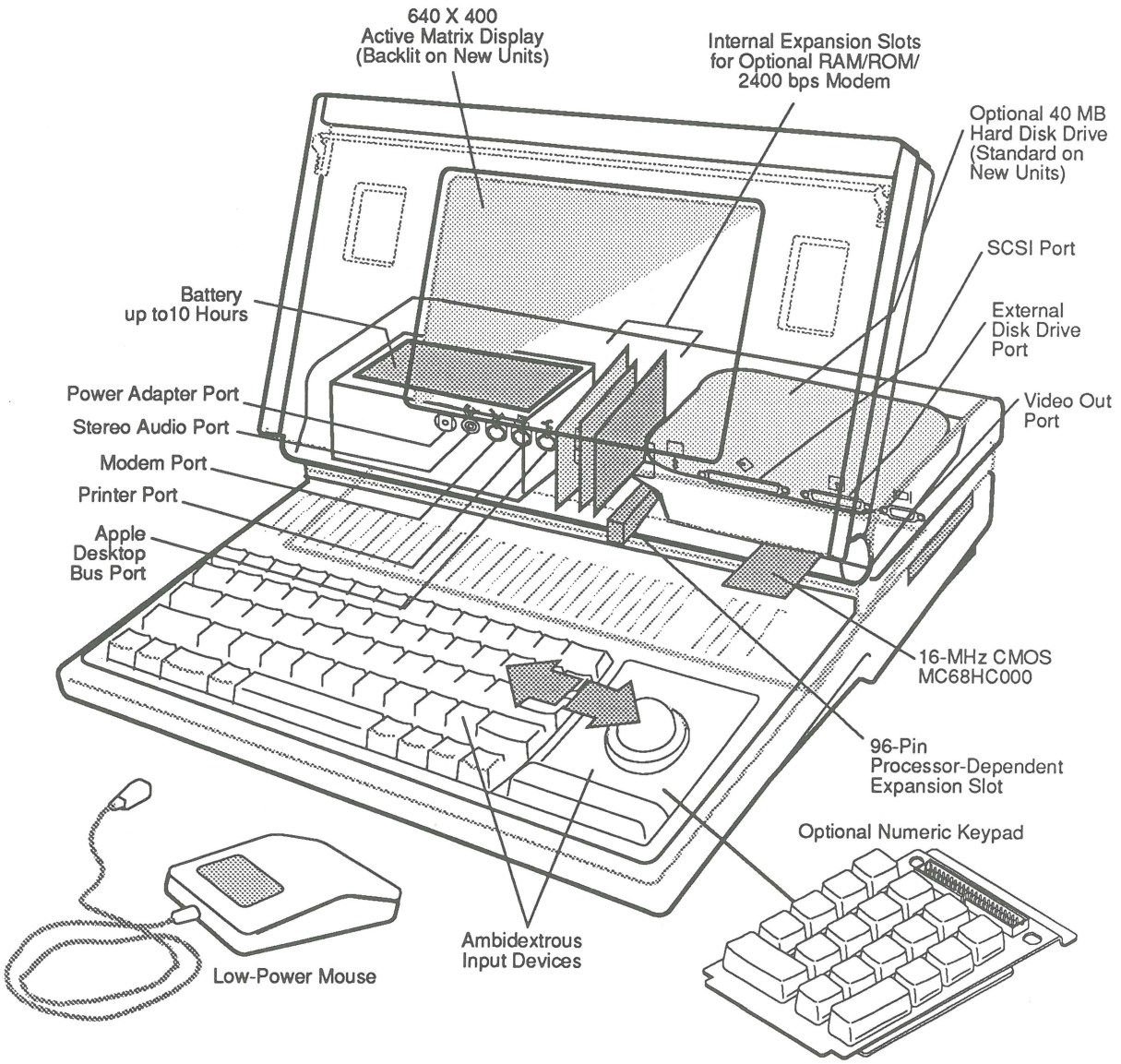

640 X 400
Active Matrix Display
(Backlit on New Units)
Internal Expansion Slots
for Optional RAM/ROM/
2400 bps Modem
Optional 40 MB
Hard Disk Drive
(Standard on
New Units)
SCSI Port
Battery
up to10 Hours
External
Disk Drive
Port
Power Adapter Port
Stereo Audio Port
Video Out
Port
Modem Port
Printer Port
Apple
Desktop
Bus Port
16-MHz CMOS
MC68HC000
96-Pin
Processor-Dependent
Expansion Slot
Optional Numeric Keypad
Ambidextrous
Input Devices
Low-Power Mouse

FIGURE 1

❑ PRODUCT DESCRIPTION

Configurations

The original Macintosh Portable is available from Apple in two configurations:

- Single floppy drive system
- Single floppy drive and 40-MB SCSI hard drive system

Both systems have 1 MB of static RAM.

The new Macintosh Portable is also available in two configurations:

- Single floppy drive and 40-MB SCSI hard drive system with 1 MB of pseudostatic RAM.
- Single floppy drive and 40-MB SCSI hard drive system with 2 MB of pseudostatic RAM. The system includes a 1 MB RAM expansion card.
- Single floppy drive and 40-MB SCSI hard drive system with 4 MB of pseudostatic RAM. The system includes a 3 MB RAM expansion card.

These are not the only possible configurations. Apple offers a number of options to enhance the operation of the Portable. These options are described later in this section. Since the Portable offers a number of expansion connectors, third-party products may be installed. You may see systems with different amounts of RAM, different hard disk drives, optional modem, RAM or ROM cards, external peripherals, and third-party options.

Module Identification

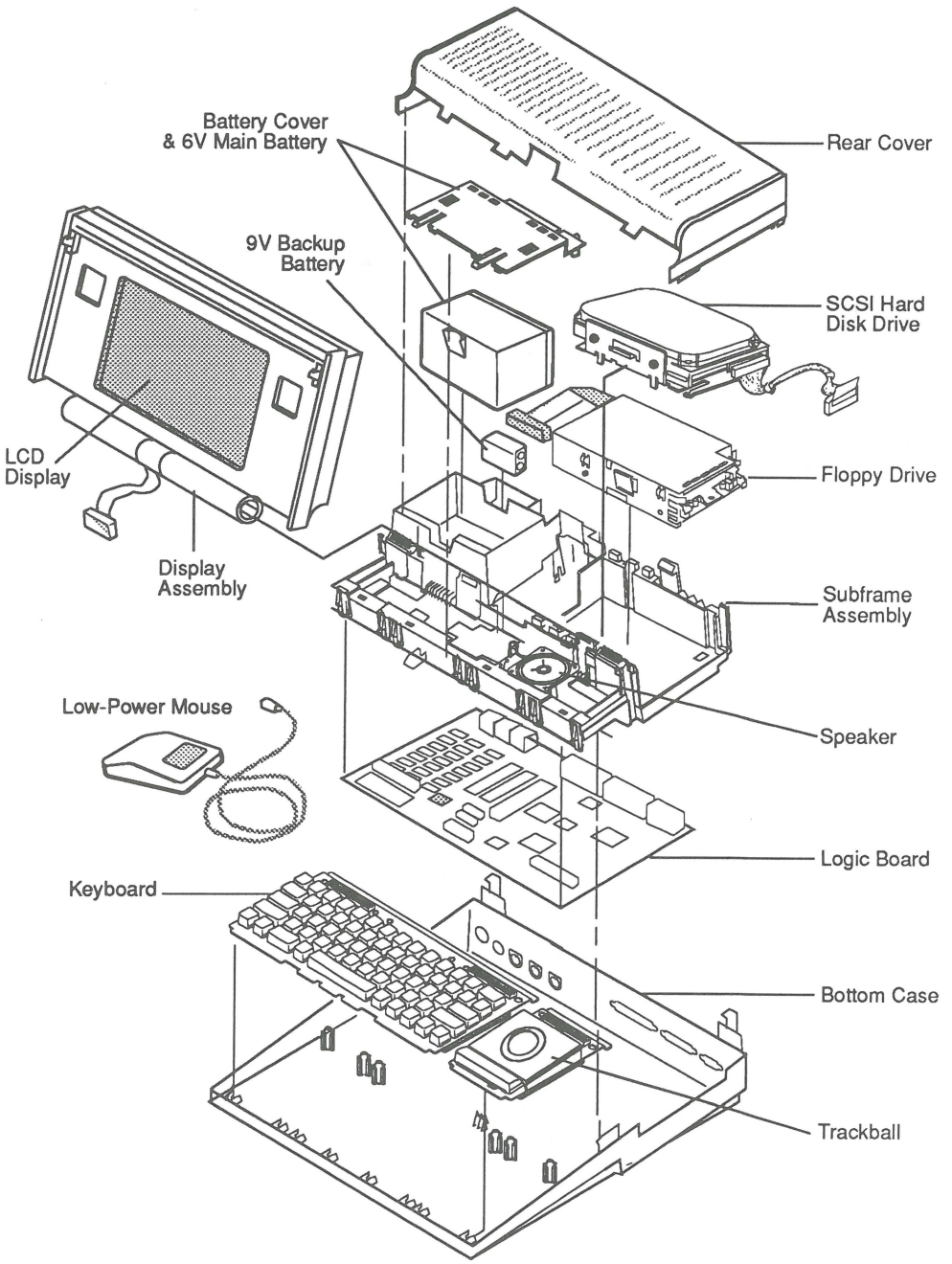


FIGURE 2

❑ PRODUCT DESCRIPTION

Options

Apple offers a number of options to enhance the performance and usability of the Macintosh Portable.

- 2400 bps internal modem
- 1 MB static RAM expansion card (original Portable only)
- 1 MB and 3 MB pseudostatic RAM expansion card
- Battery recharger
- 40 MB SCSI hard disk drive (original Portable only)
- 1.4 MB FDHD SuperDrive floppy disk drive
- Numeric keypad

Technical procedures for all the above options are provided in Section 5, Additional Procedures. Troubleshooting for the floppy drive and SCSI hard disk is included in Section 4, Troubleshooting.

The following is an overview of each of these options and their associated technical procedures.

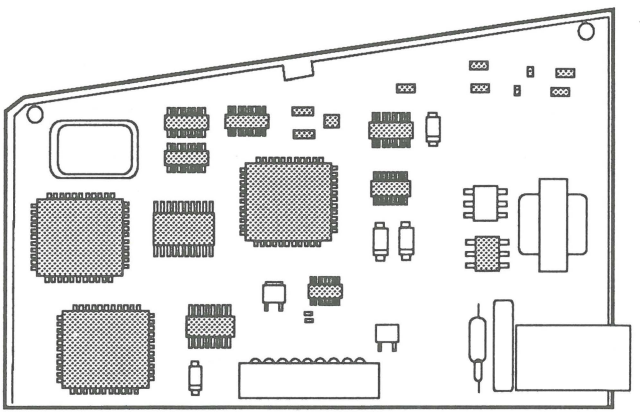
Portable Data Modem 2400 and the Int'l XP 2400

Figures 3-A, 3-B, 3-C, and 3-D. The Portable Data Modem 2400 (United States and Canada) and the Int'l XP 2400 (international) are internal 2400 bps modems. These modems allow the Portable to communicate with remote computers without an external device. The Data Modem 2400 is shown in **Figure 3-A**. The Int'l XP 2400 is shown in **Figure 3-B**. A Data Access Arrangement (DAA) adapter for the Int'l XP 2400 is shown in **Figure 3-C**. The MNP option board for the Int'l XP 2400 is shown in **Figure 3-D**. Technical procedures for these cards cover installation, check-out, and troubleshooting.

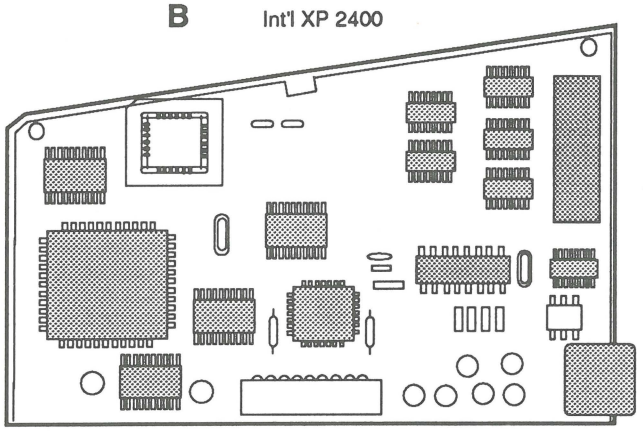
1 MB RAM Expansion Card (Static)

Figure 3-E. The 1 MB RAM Expansion Card is a 1 MB static RAM card. This card is compatible only with the original Macintosh Portable. Installing the card increases the amount of memory available for applications and data from 1 to 2 MB. Installation, check-out, and troubleshooting procedures for the card are provided.

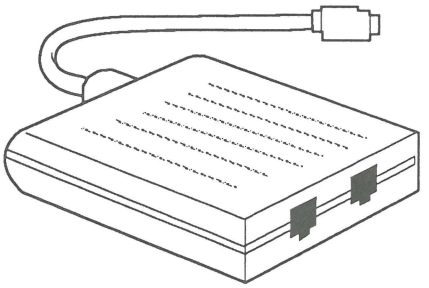
A Portabale Data Modem 2400



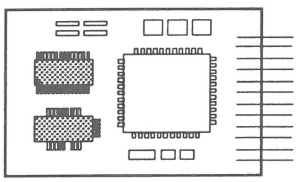
B Int'l XP 2400



C Data Access Arrangement (DAA)



D MNP Board



E 1 MB RAM Expansion Card (Static)

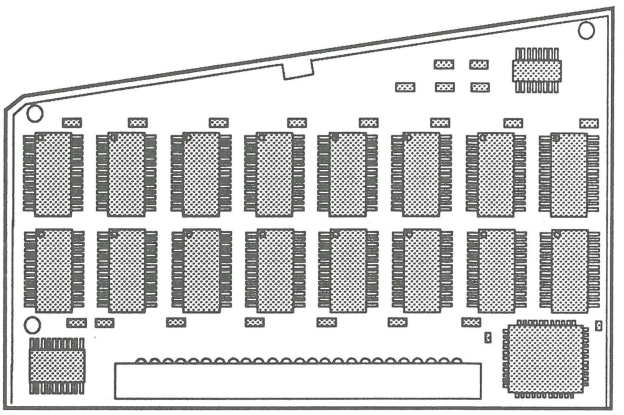


FIGURE 3

❑ PRODUCT DESCRIPTION

1 MB and 3 MB RAM Expansion Cards (Pseudostatic)

Figure 4-A. The 1 MB and 3 MB RAM Expansion Cards are pseudostatic RAM cards. These cards are compatible only with the pseudostatic logic board. These cards increase the amount of memory to 2 MB or 4 MB. Installation, check-out, and troubleshooting procedures for these cards are provided.

Note: These cards can only be ordered at the time of purchase. They are not available separately.

Battery Recharger

Figure 4-B. The optional external battery recharger is used to recharge the main battery while an optional second battery is used in the computer. Technical procedures cover operation and troubleshooting.

40 MB SCSI Hard Disk Drive

Figure 4-C. An optional 40 MB SCSI hard disk drive is available. The drive is a low-power, one-third-height, 3.5-inch model. The low-power feature makes the drive ideal for use in a battery-operated portable computer. The drive is also lightweight, rugged, and fast. The Portable supports a maximum of two internal disk drives. The computer can have either two floppy disk drives or one floppy drive and one hard disk. Installation, check-out, and troubleshooting procedures are provided.

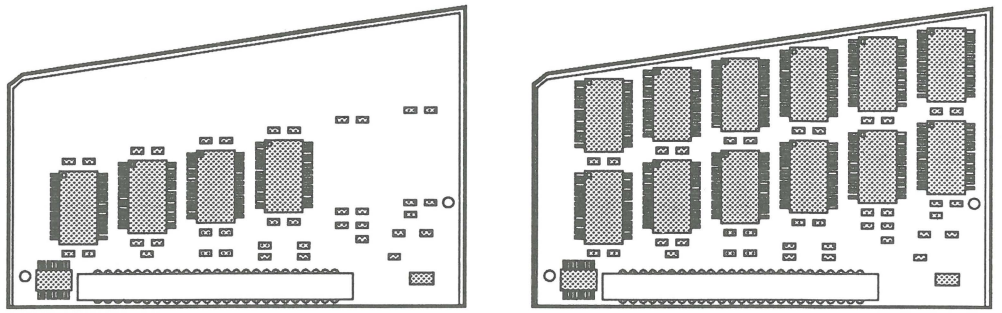
1.4 MB FDHD SuperDrive Floppy Disk Drive

Figure 4-D. An optional second Apple FDHD SuperDrive floppy disk drive is available for the original Portable. This drive provides an additional 1.4 MB of permanent storage. The Portable supports a maximum of two internal disk drives. (The new Portable is configured from the factory with a floppy and hard disk installed.) The computer can have either two floppy disk drives or one floppy drive and one hard disk. Procedures are included for installation, check-out, and troubleshooting.

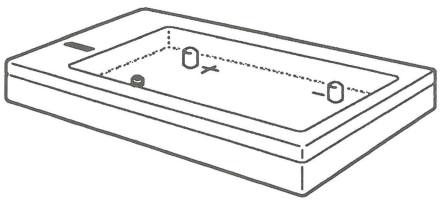
Numeric Keypad

Figure 4-E. The optional numeric keypad can be installed in place of the trackball. To use the numeric keypad, remove the trackball and use the low-power mouse instead. Installation procedures are located in Section 5, Additional Procedures, "Reconfiguring Input Devices."

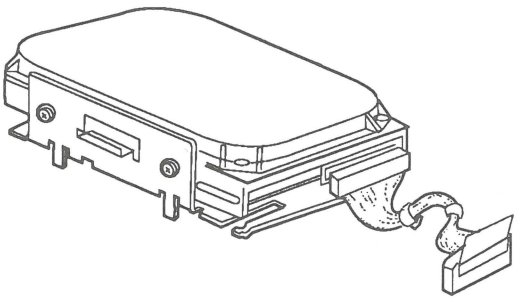
A 1 MB and 3 MB RAM Expansion Cards (Pseudostatic)



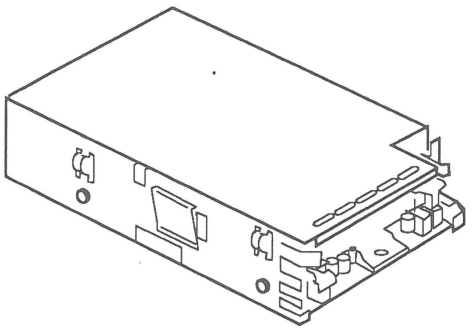
B Battery Recharger



C 40 MB SCSI Hard Disk Drive



D 1.4 MB Floppy Disk Drive



E Numeric Keypad

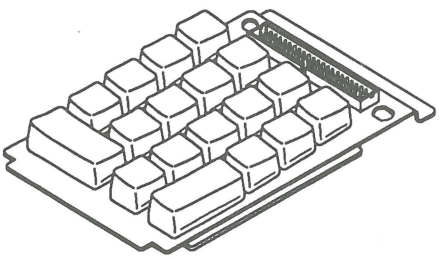


FIGURE 4

❑ CONNECTOR AND SWITCH IDENTIFICATION

Rear Panel

Figure 5-A. The Macintosh Portable has seven interface connectors, one power connector, and an opening for the connector for the optional modem card on its rear panel. Pin-outs and signal descriptions for the interface connectors can be found in the *Apple Service Technical Procedures Peripheral Interface Guide.*

Internal

Figures 5-B. The logic board has seven connectors. A static RAM logic board has a four-position DIP switch; a pseudostatic RAM logic board has one jumper block.

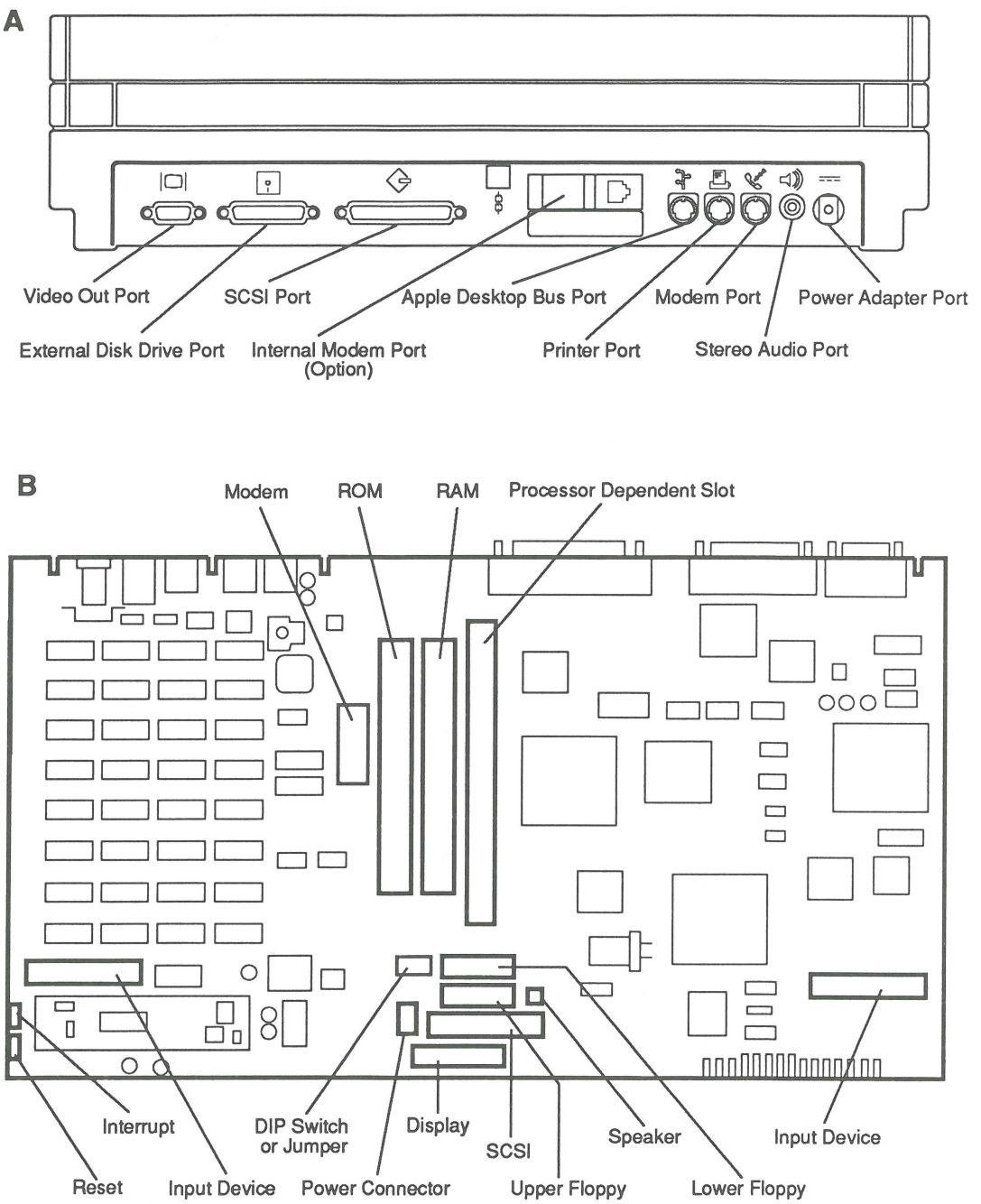

A
Video Out Port
SCSI Port
Apple Desktop Bus Port
Modem Port
Power Adapter Port
External Disk Drive Port
Internal Modem Port
(Option)
Printer Port
Stereo Audio Port
B
Modem
ROM
RAM
Processor Dependent Slot
Interrupt
DIP Switch
or Jumper
Display
SCSI
Speaker
Input Device
Reset
Input Device
Power Connector
Upper Floppy
Lower Floppy

FIGURE 5

❑ THEORY OF OPERATION

Introduction

The Macintosh Portable computer is made up of six modules: logic board, Apple FDHD disk drive, input devices, LCD display, main and backup batteries, and external power adapter. A combination of two input devices is present. The combination of input devices can be either a keyboard and trackball, or a keyboard, numeric keypad, and mouse. A system block diagram is shown in **Figure 7**.

The information here will give you an understanding of how each module of the Macintosh Portable computer works, as well as how the system functions. This will assist you in performing logical troubleshooting on the Macintosh Portable computer.

Logic Board

Figure 6. The logic board is the heart of the system, the place where all processing of information takes place. Power management and battery recharging, video display memory and interface circuitry, and peripheral and expansion interfaces are also contained on the logic board. What follows is a list of the major components of the Macintosh Portable logic board and the functions they perform.

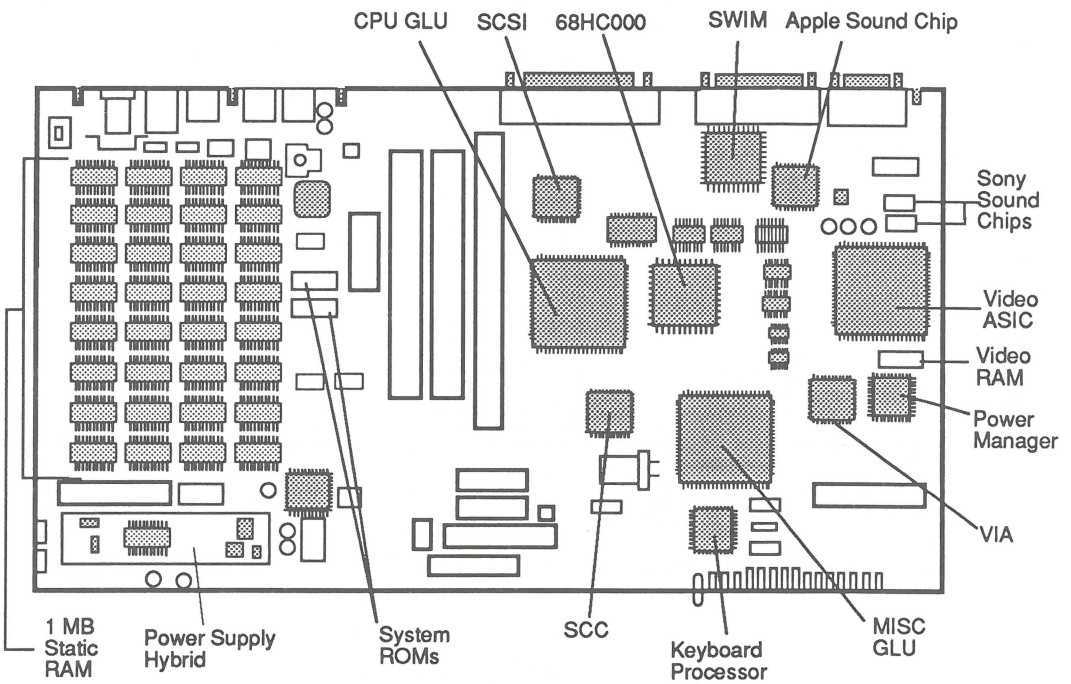


FIGURE 6

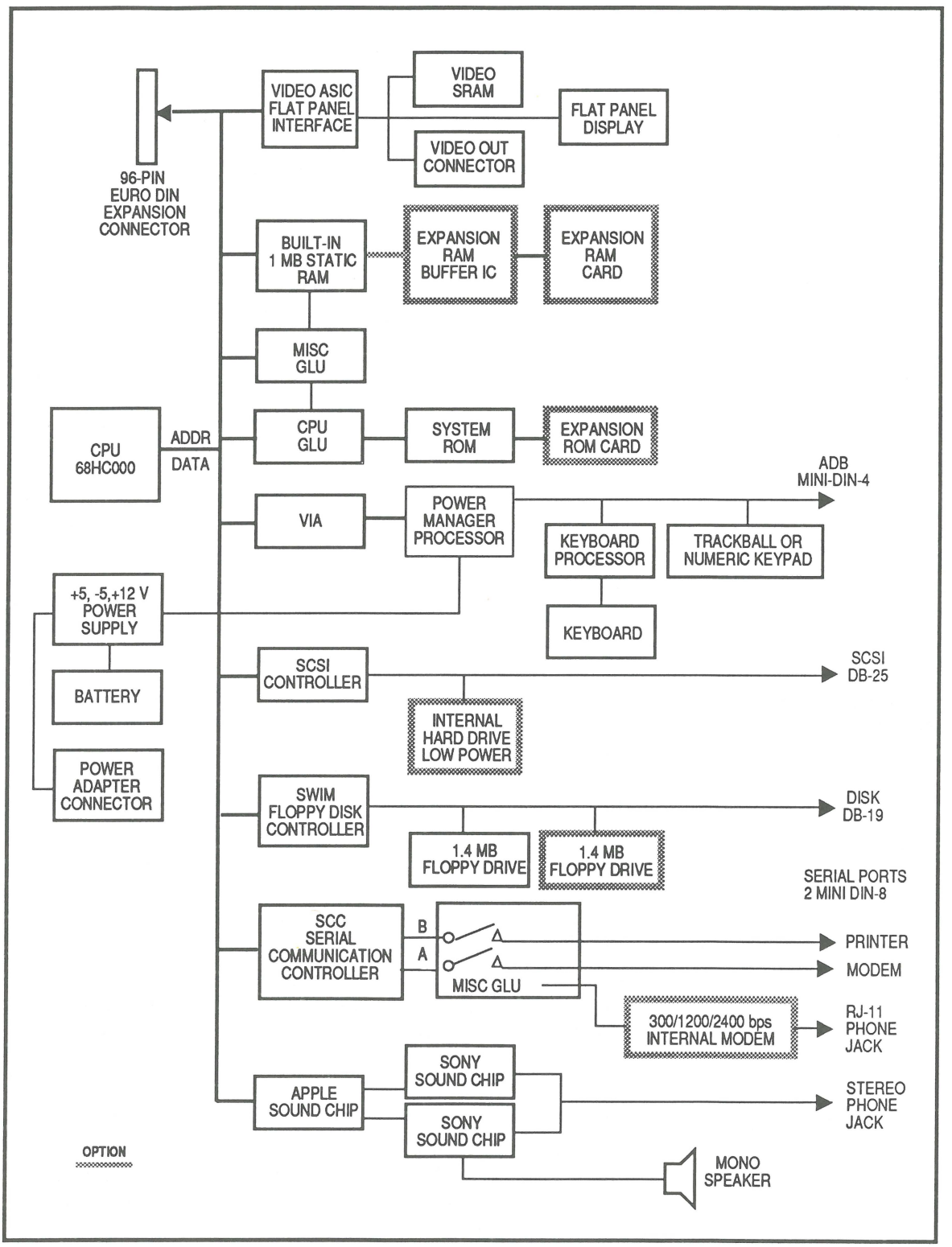

VIDEO ASIC FLAT PANEL INTERFACE
VIDEO SRAM
FLAT PANEL DISPLAY
VIDEO OUT CONNECTOR
96-PIN EURO DIN EXPANSION CONNECTOR
BUILT-IN 1 MB STATIC RAM
EXPANSION RAM BUFFER IC
EXPANSION RAM CARD
MISC GLU
CPU 68HC000
ADDR
DATA
CPU GLU
SYSTEM ROM
EXPANSION ROM CARD
ADB MINI-DIN-4
VIA
POWER MANAGER PROCESSOR
KEYBOARD PROCESSOR
TRACKBALL OR NUMERIC KEYPAD
KEYBOARD
+5, -5,+12 V POWER SUPPLY
BATTERY
POWER ADAPTER CONNECTOR
SCSI CONTROLLER
SCSI DB-25
INTERNAL HARD DRIVE LOW POWER
SWIM FLOPPY DISK CONTROLLER
DISK DB-19
1.4 MB FLOPPY DRIVE
1.4 MB FLOPPY DRIVE
SERIAL PORTS 2 MINI DIN-8
SCC SERIAL COMMUNICATION CONTROLLER
B
A
PRINTER
MODEM
MISC GLU
300/1200/2400 bps INTERNAL MODEM
RJ-11 PHONE JACK
SONY SOUND CHIP
APPLE SOUND CHIP
SONY SOUND CHIP
STEREO PHONE JACK
OPTION
MONO SPEAKER

FIGURE 7

❑ THEORY OF OPERATION

Microprocessor

The Macintosh Portable contains a Motorola MC68HC000 16-bit microprocessor operating at 15.667 MHz. This processor is completely software compatible with the 8-MHz 68000 used in the Macintosh, Macintosh Plus, SE, and Classic; the 32-bit 68020 used in the Macintosh II and LC; and the 32-bit 68030 used in the Macintosh SE/30 and Macintosh IIx, IIcx, IIci, IIfx, and IIsi. The Portable will, therefore, run most existing Macintosh applications without modification. (The latest list of applications compatible with the Portable can be found in the Technical Information Library on AppleLink®.)

CPU GLU IC

The CPU GLU (general logic unit) IC is an Apple-designed custom gate array that performs a variety of support functions for the microprocessor. The CPU GLU provides an interface between the 68HC000 and system RAM and ROM, SCC, SCSI, VIA, SWIM, and Video ASIC peripheral chips. Also, the 96-pin expansion connector interface and a number of miscellaneous support functions are implemented.

Power Manager Microprocessor

The Portable uses a Mitsubishi M50753 microprocessor to perform a variety of control and support functions. This processor is referred to as the power manager.

The M50753 contains RAM, ROM, I/O ports, an analog-to-digital converter, a pulse-width modulation (PWM) output, and an 8-bit timer. These are used to monitor the battery charge level, govern power and clocks to the internal peripheral chips and devices, implement the Apple Desktop Bus transceiver and Macintosh real-time clock, and control the screen contrast setting. The operation of the power manager is discussed in greater detail in "Functional Overview."

Power Supply Hybrid

The power supply hybrid is a combination digital and analog device used to convert the 6.5 volts from the main battery to the voltages required by the computer. This chip also monitors the voltages available from the power adapter and the main battery.

RAM

The Portable comes with 1 MB of static random access memory. This 1 MB of RAM (referred to hereafter as system RAM) is available for use by the Macintosh operating system, applications, and data. (Video display memory is separate from system RAM and is discussed in the "Video Display Circuitry" section.) The memory is implemented using thirty two 32K x 8-bit RAMs with an access time of 100 nanoseconds. Static RAM is used instead of the dynamic RAM found on other Macintosh computers to reduce power consumption and relieve the 68HC000 from the task of providing the periodic refresh required by dynamic RAMs. To further reduce power consumption, 32K x 8-bit devices are used. By using RAMs 8-bits wide, only two are required to implement a 16-bit data width. Due to the nature of Macintosh applications, most programs run for extended periods in tight loops. This means that only two RAMS are required at any one time. All others can be in standby mode—requiring approximately 1/500th the power.

The contents of system RAM are maintained by battery power when the computer is in sleep mode. The contents will be maintained as long as the battery is charged.

RAM Expansion

RAM expansion is provided through a single 50-pin connector. All the required address, data, control, and power signals are brought to this connector. The memory expansion card installed here can contain a maximum of 4 MB. Note that this connector is electrically different than the ROM expansion slot. Therefore, the cards cannot be interchanged in their connectors. Presently, Apple has an optional 1 MB expansion card available. Further information on the RAM expansion card can be found in Section 5, Additional Procedures.

ROM

The Portable has 256K of nonvolatile read-only memory. Two 128K x 8-bit devices are used. These ROMs, which are based on the Macintosh SE ROMs, contain the Macintosh ToolBox; diagnostics and self-tests; support for the power manager, real-time clock, and Apple Desktop Bus; and other extensions to support the Portable.

System ROM upgrades are accomplished by installing an expansion ROM card containing new system ROMs in the ROM expansion connector and disabling the on-board ROMs via DIP switches (static logic board) or a jumper (pseudostatic logic board).

ROM Expansion

Like RAM expansion, ROM expansion is provided through a single 50-pin connector. All required address, data, control, and power signals are brought to this connector. Note that this connector is electrically different from the RAM expansion slot. Therefore, the cards cannot be interchanged in their connectors.

The ROM expansion card can contain a maximum of 3.75 MB. This card can contain a variety of software, including new versions of the system ROMs from Apple and various software from third-party developers.

Input / Output Interfaces

The Portable offers a number of input/output interfaces:

- Two RS-422 serial ports – The serial ports include support for the internal modem card and are controlled by the Serial Communications Controller (SCC) circuitry.
- Floppy disk interface – The floppy interface can support two internal FDHD disk drives and a single 800K or 1.4 MB external drive. The interface is controlled by the SWIM circuitry.
- SCSI interface – Supports the optional internal SCSI hard drive and up to six additional external SCSI devices. This interface is controlled by the 53C80 SCSI controller circuitry.
- Apple Desktop Bus – This is a low-speed serial interface used to provide communication between the CPU and input devices. The Portable contains a total of three ADB connectors. Two connectors support the connection of the internal keyboard and trackball or numeric keypad. The third is an external connector for connecting an external device, such as a mouse or external keyboard.

- Stereo sound port – The Portable contains stereo sound capability. Sound is controlled by the Apple and Sony Sound Chip circuitry.

Each of these interfaces is compatible with its counterparts found on Macintosh SE and II family computers.

The Portable also has several other interfaces not found on other Macintosh computers:

- Video interface – The video interface supports the built-in LCD display and the video-out port at the rear of the computer. The video interface is designed around the Video ASIC. The external video-out port supplies the same signals that are sent to the internal display and requires the Macintosh Portable Video Adapter (or an equivalent device) to convert the information into a form that can be used by an external video display, such as the Apple High-Resolution Monochrome Monitor.

- Expansion interface – Expansion capability is provided by a 96-pin connector called the Processor Dependent Slot (PDS). This connector is electrically, but not physically, compatible with the expansion connector on the Macintosh SE. The Misc GLU and Video ASICs provide interface support between the CPU and the expansion connector.

Serial Communications Controller (SCC)

The two serial ports are controlled by an 8530 Serial Communications Controller (SCC). Port 1, the modem port, can be programmed for asynchronous or synchronous protocols. Port 2, the printer port, can be programmed for asynchronous or AppleTalk® operation. The serial ports conform to the EIA RS-422 standard. These ports are used mainly for (though not limited to) connecting the Portable to AppleTalk networks or serial printers and modems.

The Portable uses two mini DIN-8 connectors for the two ports. These are the same connectors found on all Macintosh computers since the Macintosh Plus. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K enhanced serial ports.

Port 1, the modem port, is also used to communicate with the internal modem. When the modem is installed, the computer automatically selects the modem and disables the external serial port. The interface between the computer and modem is RS-232 and uses an 18-pin connector.

Note: When the internal modem is installed and selected, the external modem port is disabled. It is not possible to use both simultaneously.

SWIM Chip

The SWIM chip in the Macintosh Portable is a complete multimode floppy disk interface on a single IC. The SWIM is an enhanced version of its predecessor, the IWM, which is found in the Macintosh, Macintosh Plus, SE, and II. The SWIM chip incorporates the features of the IWM and provides the additional ability to read, write, and format in Group Coded Recording (GCR) and Modified Frequency Modulation (MFM) data formats. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (variable rotational speed) or MFM (constant rotational speed) formats. This arrangement provides the ability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS™ and OS/2™ 720K data disks (MFM), and Apple or MS-DOS and OS/2 high-density (1.4 MB) data disks (MFM). The disk interface on the Portable supports up to two internal drives and one external drive—a total of three drives.

Small Computer System Interface (SCSI)

The Small Computer System Interface (SCSI) consists of the 53C80 SCSI controller IC, an internal 34-pin connector to connect an optional internal SCSI hard disk, and an external DB-25 connector to attach up to six additional external SCSI devices. The SCSI controller is connected directly to both connectors, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. Each SCSI device has a unique address. This address is used to direct information between devices. The Macintosh computer is always address 7. The optional internal hard disk is address 0. External SCSI devices can be addressed from 0 to 6. (If an internal hard disk is installed, address 0 cannot be used.)

The Apple SCSI interface differs from the industry SCSI standard in two ways:

1. A DB-25 connector is used instead of the standard 50-pin "D" connector to attach external SCSI devices. The *Apple SCSI System Cable* is available to convert the connector to the standard.

2. Power for termination resistors is not provided. If the attached SCSI device does not have the required terminator resistor, the external device must either include a built-in terminator or provide power for an external terminator.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a low-speed serial communication bus used to connect input devices to the computer. ADB can be used to connect devices like keyboards and pointing devices. The standard input devices, the keyboard and trackball, are connected to the logic board via 34-pin flat cables. External ADB devices connect to the computer via a mini DIN-4 connector on the rear panel. Unlike other Macintosh computers with an ADB interface, the Portable does not use the standard ADB chip. The Portable has the function of the ADB chip incorporated into the power manager microprocessor.

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. In the Portable, the microprocessor for the keyboard is part of the logic board. All external ADB devices, except the mouse, have a second ADB connector for connecting to other ADB devices. Because it has no connector, the mouse must be the last device attached to the Apple Desktop Bus.

❑ THEORY OF OPERATION

Apple Sound Chip

The Apple Sound Chip generates a stereo audio signal. This signal is buffered by two Sony audio chips that filter the pulse-width-modulated (PWM) signal and drive the internal speaker (mono) or external audio port (stereo).

The sound generation system in the Macintosh Portable supports the previous Macintosh modes; it also offers a set of ROM tools known as the Sound Manager for performing sound generation.

Video Display Circuitry

The Portable has a special video interface to support the LCD display. The interface is based around the Video ASIC. The Video ASIC controls the interface between the CPU, video RAM, and the LCD display. This circuit also sends data and control signals to operate the display.

A 32K x 8-bit static RAM provides video display memory separate from main system memory. This separate video memory increases the amount of RAM available for use by applications and data and also eliminates contention problems between the CPU and video display circuitry. The elimination of contention problems improves system throughput.

Versatile Interface Adapter

The Macintosh Portable contains one 65C22A Versatile Interface Adapter (VIA). The VIA provides an 8-bit bidirectional data bus and handshaking between the power manager microprocessor and the 68HC000, floppy drive head selection, and miscellaneous support for the internal modem, SCSI interface, and SCC.

Expansion Interface

The Portable has a 96-pin EuroDIN connector to provide system expansion capabilities. All the 68HC000 data, address, and control signals and are brought to this connector. This connector, although it contains the same signals as the one in the Macintosh SE, does not support SE expansion cards. Interface support between the 68HC000 and the expansion slot are provided by the Video ASIC.

Apple FDHD Disk Drive

Each internal floppy disk drive connects to the logic board through a 20-pin connector. The flow of data between the logic board and the disk drives is channeled through the SWIM disk controller. The SWIM controls reading and writing operations.

The Macintosh operating system does not recognize other disk formats so an application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

Keyboard

The keyboard used in the Portable is modeled after the Apple Keyboard used with the Macintosh SE. Communication between the CPU and keyboard is via an Apple Desktop Bus connector on the logic board. The connecting cable is a 34-pin flat cable. A keyboard processor located on the logic board interprets the signals coming from the keyswitch matrix.

Trackball

To provide a truly portable computer, a trackball has been provided to use in place of the Apple Desktop Bus mouse. The trackball emulates the mouse in operation and communicates with the CPU via the Apple Desktop Bus. A 34-pin flat cable connects the trackball to the logic board.

Low-Power Mouse

The low-power mouse can be used when the optional numeric keypad is installed and the trackball is unavailable or whenever a mouse is desired. The Portable requires the use of a special low-power version of the mouse to minimize power use. Apple strongly recommends that the regular ADB mouse not be used with the Portable.

Low Power Devices

FIGURE 8

Figure 8. Devices which receive power from the computer, such as the mouse and hard disk, are available in low-power versions. These low-power devices display an icon to indicate they are specially designed for use with the Macintosh Portable. These low-power devices should be used wherever possible to provide maximum system operation when running on battery power.

❑ THEORY OF OPERATION

LCD Display

The Macintosh Portable uses a new flat-panel display technology called reflective active matrix. Active matrix technology was chosen for several reasons:

- Low power
- Fast response
- Large contrast and viewing angle
- Bright
- Durable
- Low weight

Figure 9. The display operates by the reflection of light from the front surface onto a reflector plate at the rear of the display. The display has high contrast in all but very low-light levels.

The display is made up of 640 pixels horizontally and 400 pixels vertically, for a total of 256,000 pixels. The result is a resolution of 75 pixels (dots) per inch (dpi). The density is slightly more than the normal 72 dpi of the Macintosh, Macintosh Plus, SE, and SE/30, resulting in a slight variation in the display aspect ratios.

Screen contrast is software selectable through the Portable control panel device (CDEV) in the Control Panel. (Refer to "System Software" later in this section.) The power manager microprocessor contains a digital-to-analog (D/A) converter, which is used to select one of 32 contrast levels.

Screen Defects

Screen defects fall into three categories—voids, stuck pixels, and black lines or streaks. A void is a pixel that will not turn on. Apple specifications permit a maximum of five voids per display. A display which has six or more voids is considered defective and should be replaced. A stuck pixel is any pixel which never turns off. A display with any stuck pixels should be replaced. Black lines or streaks can be seen as either a row or column of pixels that is stuck on or as a "ghost" of an image on the display. Any display that exhibits black streaks or lines should be replaced.

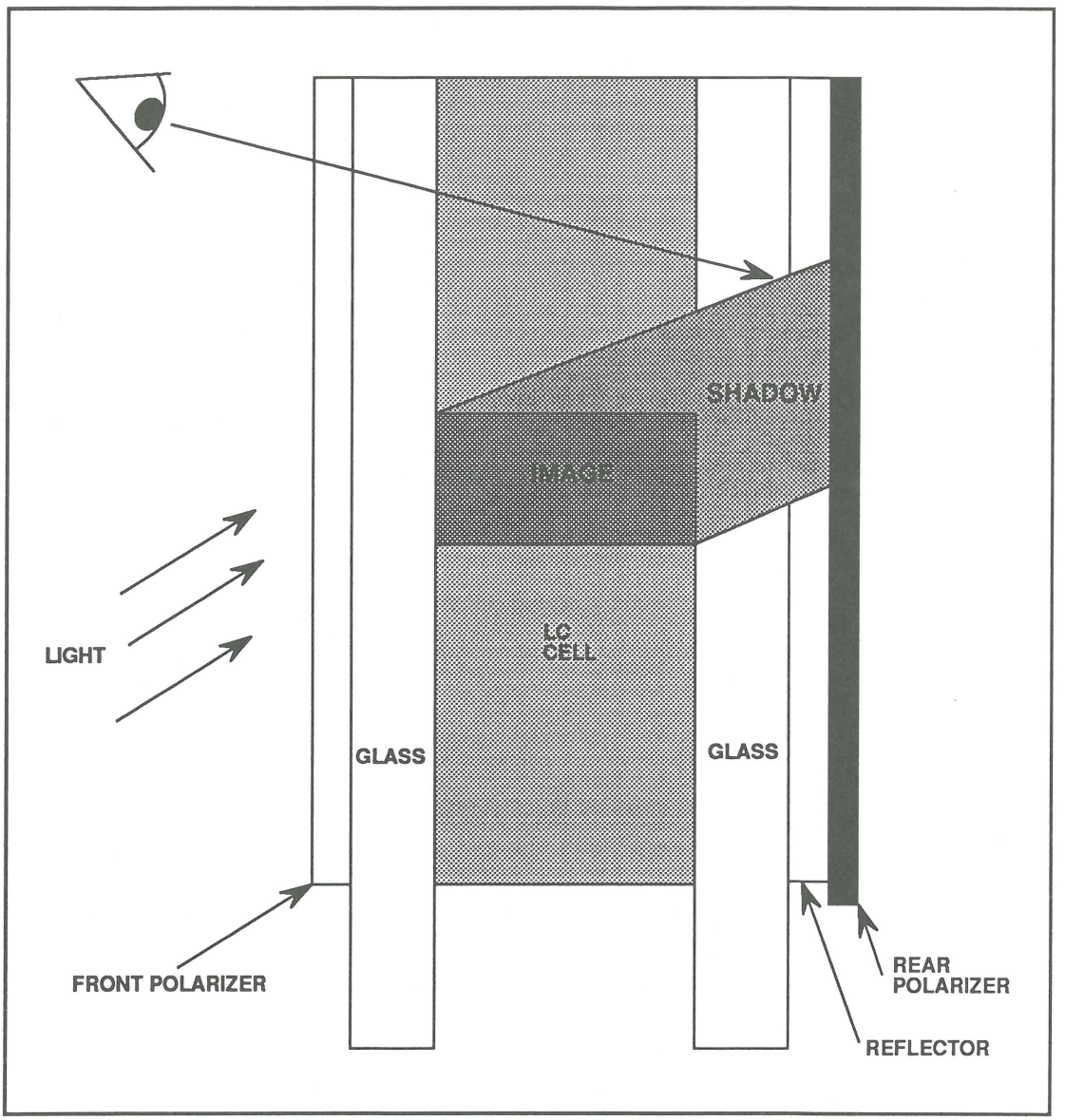

SHADOW
IMAGE
LIGHT
LC
CELL
GLASS
GLASS
FRONT POLARIZER
REAR
POLARIZER
REFLECTOR

FIGURE 9

❑ THEORY OF OPERATION

Main and Backup Batteries

The main battery used in the Portable is a rechargeable, sealed, lead-acid battery providing 6.5 volts DC. The battery is designed to be easy to install and remove by having no connecting wires. The battery connects via a wiring harness to the main logic board where the power supply hybrid converts the 6.5 volts to the +5, -5, and +12 volts required by the computer. The floppy disk drives, LCD display, input devices, external ADB devices, option cards, and optional SCSI hard disk drive receive their power from the logic board. Power management of these devices is handled by the power manager microprocessor.

The backup battery is a non-rechargeable 9-volt transistor battery. The battery connects to the logic board via the same wiring harness that connects the main battery. The battery is located in the rear of the main battery compartment. This battery supplies power to the logic board when the main battery has been removed or has been exhausted.

The backup battery is also used to maintain power to the system when the main battery is removed from the computer. This allows the contents of system and parameter RAM to be maintained while replacing the main battery. The battery being used is determined by the state of a microswitch located in the battery compartment. The battery cover has a tab that activates the microswitch when the cover is installed. When the cover is installed and the microswitch closed, the computer will use the main battery as its power source. However, whenever the cover is removed, the main battery is switched out and the backup battery is used.

Note that the power manager is not connected to this microswitch and is unaware of which battery is being used. This means that should an attempt be made to startup the system or have it return from system sleep the power manager will not know that the backup battery is being used. The backup battery, however, does not provide enough power to operate the system and the battery will be drained and require replacement. Also, damage could be done to the computer.

Handling

The Macintosh Portable main battery cannot be recharged if it has been completely discharged or otherwise damaged. The battery contains toxic materials (lead and sulfuric acid). The battery is sealed, but small amounts of sulfuric acid may leak if the battery is damaged.

To extend the life of the battery:

- Handle the battery carefully.
- Recharge the battery only as described in the *Macintosh Portable Handbook* and only in ventilated areas.
- Do not leave the battery in the Portable for longer than two weeks without plugging in the power adapter.
- If you store the battery, recharge it before storing. Store the battery in a cool, dry place.
- Do not leave a battery in storage for longer than six months without recharging.
- Do not drop, puncture, disassemble, mutilate, or incinerate the battery.
- Do not short-circuit the battery terminals. Shorting can cause an explosion or fire.

Important: You will not be able to recharge a battery that has been completely discharged or otherwise damaged.

WARNING: *Sulfuric acid can cause severe burns to the skin and eyes. If you touch a damaged battery, immediately wash your hands and any other affected skin with water for at least five minutes.*

Disposal

Dispose of a dead, undamaged battery by placing it in the packaging that came with the replacement. Return the dead battery to Apple for proper disposal.

Power Adapter

The power adapter converts the AC line power to the 7.5 volts DC required by the Portable. The charger has a voltage input range of 85 to 270 volts (120/240 volts nominal) with a frequency of 48 to 62 Hz (50/60 Hz nominal). The power adapter limits output current to 1.5 amps.

❑ THEORY OF OPERATION

Functional Overview

The following sections describe the operation of the Macintosh Portable. This information is valuable in helping you logically troubleshoot the system.

Power System

The Macintosh Portable uses +5, +12, and -5 volts DC to power its various components. These voltages are generated by applying the 6.5-volts from the main battery to the power supply hybrid. The power supply hybrid, which is comprised of a combination of analog and digital circuitry, also monitors the main battery voltage, monitors and controls the charging of the main battery, and monitors the power adapter input voltage.

If the battery voltage falls below +5.65 volts, the power monitor circuit will turn off power to the computer with the exception of itself and the circuit monitoring the input from the power adapter. Prior to doing so, the user will be prompted a number of times that the battery voltage is approaching a very low level and either the power adapter should be connected or a charged battery installed. If this is not done, the computer will shut-down. The computer cannot be turned on again until the power adapter is connected or a charged battery is installed. To prevent battery sulfation, the monitor circuit will turn off the +12 and -5 volt power supplies.

The power adapter input voltage is continuously compared with the battery voltage to determine if the battery requires recharging. If the power adapter is connected to the computer, has power applied to it, and the battery is below 6.4 volts, the battery will begin charging.

The power manager also uses the information from the battery voltage monitor to do its job of managing the power consumption of internal peripheral chips and devices. Components which are not needed are powered off to conserve power. Two methods are available to reduce peripheral device power consumption—clock control and power control.

Clocked devices—the SWIM and SCC—reduce their power consumption by removing the clock input to the chip. For devices that do not have a clock input, the power to the chip must be removed to reduce power consumption. The -5 and +12 volt power supplies, the serial line drivers, the Apple Sound Chip, SCSI controller, and internal modem card are in this category.

The 68HC000 is grouped with system RAM, ROM, and some support logic for their power management. The contents of system variables, peripheral device internal registers, and the 68HC000's internal registers must be saved prior to powering down these devices. After this is done, the power manager can then place the RAM, ROM, and support logic in standby mode and the 68HC000 is put in an extended wait state to reduce power consumption.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. First, the processor is held in a wait state while a series of circuits puts the system in a known state in preparation for operation. During this time, the versatile interface adapter and the SWIM chip are initialized, and the mapping of RAM and ROM is altered temporarily in order to test the system.

The software contained in the Read-Only Memory (ROM) then performs a RAM test to determine how much RAM is present in the machine and to verify the proper operation of that RAM. Several other system tests are then performed. When the system is fully tested and initialized, system RAM is mapped for normal operation.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1) Internal floppy disk drive—lower drive first, followed by upper drive
2) External floppy disk drive
3) Startup device set in the control panel
4) RAM disk containing a valid system folder
5) SCSI devices—starting with internal drive, then in declining order of device ID (6 to 0)

Note: The startup device will default to the device with SCSI address 0 if both the main and backup batteries are removed, the backup battery fails, the battery cable is disconnected, or the parameter RAM is destroyed.

Once a readable disk containing boot tracks and a System Folder are found, the disk is read and the disk startup process is completed.

System Sleep and Waking

One of the requirements of a portable computer is providing for battery operation for the maximum amount of time possible. The Portable has three methods of power conservation:

- Powering off the system
- Powering off peripheral chips and internal peripheral devices when they are not needed
- Slowing the 68HC000 when full speed is not needed

The power manager will put the computer into system sleep if either a very low battery condition is detected or if the 68HC000 sends a sleep command. The 68HC000 will send the sleep command when no user activity is detected for a period of time specified in the Portable CDEV or the user selects **Sleep** from the Macintosh Finder™.

The computer can be brought out of system sleep in three ways: any key on the keyboard except <Caps Lock> is pressed, the automatic wake-up time set in the Portable CDEV matches the real-time clock time, or if an internal modem is installed and the **When Phone Rings** option of automatic wake-up is selected in the Portable CDEV.

Systems shipped from Apple with the SCSI hard disk installed will contain system software and HyperCard preloaded on the hard disk. If the software becomes unusable or the drive needs replacement, you'll need to reinstall this software. You should also install system software and HyperCard on the hard disk if you are installing the optional SCSI hard disk. The installation procedures are included here.

Features of System Software 6.0.4, 6.0.5, and 6.0.7

To support the features found on the Macintosh Portable, Apple released Macintosh system software version 6.0.4. In conjunction with the release of the Macintosh IIfx, Apple released version 6.0.5 of Macintosh system software. Although version 6.0.5 is designed to support the new features of the Macintosh IIfx, it also contains a number of fixes to problems found in earlier system software releases, including several problems unique to the Portable. Apple, therefore, recommends that Macintosh Portable equipped with nonbacklit displays use version 6.0.5 or later.

To support the backlit display and pseudostatic logic board, version 6.0.7 and the accompanying Portable CDEV version 1.3 should be used.

Installation procedures for versions 6.0.4, 6.0.5, and 6.0.7 are identical. (See "Installation Procedure.")

❑ SYSTEM SOFTWARE

Summary of Changes

The following problems are corrected in versions 6.0.5 and later:

1. The battery needs recharging after the computer is unused for four or more days. This problem is that the SCC draws excessive current when the **Shut Down** command (rather than **Sleep**) is used and AppleTalk is active. In 6.0.5, either **Shut Down** or **Sleep** can be used without draining the battery.

2. The computer fails to establish communication with serial devices or it transmits/receives garbage after waking from system sleep.

3. When using an external modem, and after exiting a communication application and putting the computer to sleep three or four times, the computer locks up when the computer comes out of system sleep.

CAUTION: *Earlier versions of Macintosh system software are not compatible with the Portable and may cause damage to the computer, reduced battery life, or loss of data.*

Some of the system software features unique to the Macintosh Portable follow.

RAM Disk

System 6.0.4 and later versions have the ability to create a RAM disk on the Portable. By copying the System file and the Finder™ to RAM disk, the Portable can boot from a RAM disk without a startup floppy or hard disk. Also, the time to load the operating system is greatly reduced. The RAM disk is created using the Portable CDEV described next.

Portable CDEV

Figure 10-A. The Portable control panel device (CDEV) lets you adjust the screen contrast (nonbacklit display) or brightness (backlit display), set sleep settings for the system and hard disk, create a RAM disk, and control the internal modem.

System Rest

The Portable has the ability to slow the microprocessor from its normal speed of approximately 16 MHz to about 1 MHz during idle periods. This feature is called *system rest* and is used to reduce power consumption by the 68HC000. The computer will switch to system rest if no input device activity occurs for fifteen seconds. The system returns to full speed when a user presses a key or moves the trackball or mouse, or a peripheral requests attention.

System rest may interfere with the operation of some programs. If you need to disable system rest, hold down the <Option> key and click anywhere on the words **Minutes Until Automatic Sleep**. The dialog box shown in **Figure 10-B** appears. Then click **Don't Rest** and **OK**.

Battery Desk Accessory

Figure 10-C. The battery desk accessory displays a representation of the battery voltage level, indicates whether the power adapter is connected, and allows the user to put the computer in sleep mode.

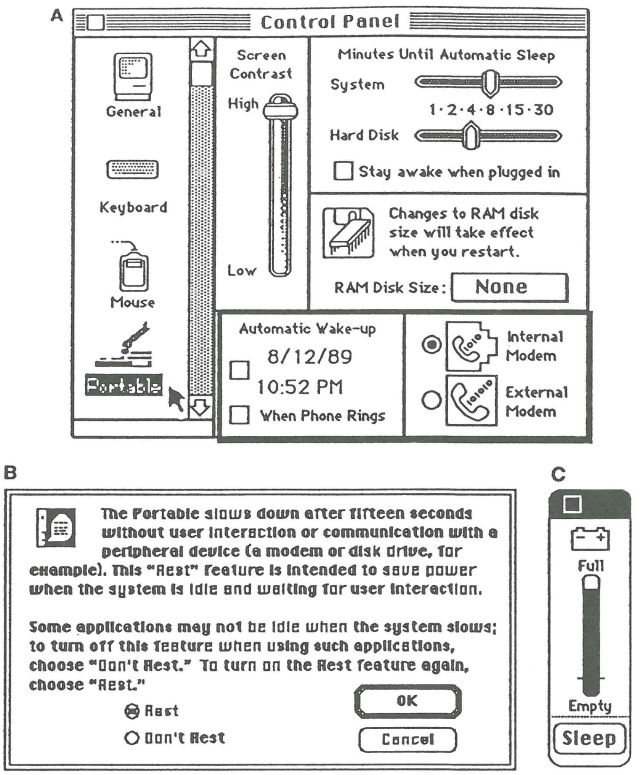


FIGURE 10

❑ SYSTEM SOFTWARE

Installation Procedure

Before beginning to install system software, be sure to make backup copies of the system software disks and use the copies to perform the installation.

Materials Required

Macintosh System Software (version 6.0.4 or later)
System Tools, Printing Tools, Utilities 1, and Utilities 2
HyperCard® software

Procedure

1. Insert the *System Tools* disk in any available floppy disk drive.
2. Turn on the computer by pressing any key except <Caps Lock>.
3. When the desktop appears, double-click on the System Tools disk to open it.
4. Double-click on the Installer to launch it.
5. When the welcome screen appears, click **OK**.
6. Select the disk you want to install system software onto. The name of the currently selected disk appears next to the disk icon. If it's not the disk you want, click **Switch Disk** until you see the name of the disk you want.
7. Click **Install**. The installer will place a complete set of system software for the Portable and printer software for all Apple printers on the selected disk.
8. When the **Installation was successful** message appears, click **Quit**.
9. Choose **Restart** from the **Special** menu. The Portable reboots.
10. When the desktop appears, create a new folder on the hard disk called HyperCard.
11. Copy the four HyperCard floppy disks to the hard disk.

System software and HyperCard installation is complete.

Processor

Type	Motorola MC68HC000, 16-bit CMOS microprocessor
Addressing	32-bit internal registers 24-bit address bus 16-bit data bus
Clock Rate	15.6672 MHz
Wait States	1 (static logic board) 10 (pseudostatic logic board)

Memory

RAM	128 bytes of system parameter memory 32K of static video display memory Static RAM Logic Board: 1 MB using thirty-two 32K x 8-bit static RAMs; 100-nsec access time; addressing supports up to 9 MB Expandable to 2 MB with optional 1 MB RAM Expansion Card Pseudostatic RAM Logic Board: 1 MB using eight 128K x 8-bit pseudostatic RAMs; 100-nsec access time; addressing supports up to 8 MB 2 MB or 4 MB when ordered with optional 1 MB and 3 MB RAM Expansion Cards, respectively
ROM	256K using two 128K x 8-bit devices; 150-nsec access time; addressing supports up to 4 MB Expandable to 4 MB with optional ROM Expansion Card

❑ SPECIFICATIONS

Display

Type	Reflective, active-matrix liquid crystal flat-panel display Backlighting available on newer models
Size	10-inch (25.4 cm) diagonal
Resolution	640 x 400 pixels, 75 dpi
Dot Size	.28 mm
Dot Pitch	.33 mm
Active Area	80%
Other	Variable tilt Contrast (nonbacklit display) and brightness (backlit display) is software adjustable using the Control Panel

I/O Devices

Keyboard	63 keys N-key rollover Apple Desktop Bus interface US, British, French Canadian, Japanese, German, Spanish, French, Swedish, and Italian versions available
Trackball	Apple Desktop Bus interface
Low-Power ADB Mouse	Low-power version of the Apple Desktop Bus Mouse Opto-mechanical type Apple Desktop Bus interface
Numeric Keypad (Optional)	18 keys Apple Desktop Bus interface US, Pacific, and European versions available
Floppy Disk Drive	1.4 MB FDHD high-density disk drive 512 bytes per sector 9 sectors per track for 800K; 18 for 1.4 MB 368.64K/side for 800K; 737.28K for 1.4 MB 737.28K/disk for 800K; 1474.56K for 1.4 MB
40-MB Hard Disk Drive (Optional)	40-MB formatted capacity Apple SCSI interface 3.5-inch, one-third-height mechanism 1:1 interleave 25-millisecond average access time (40 MB Hard Disk Drive standard on later models)

I/O Interfaces

Disk Interface	Apple SWIM chip MFM/GCR modes Supports Macintosh 800K Disk Drive, Apple 3.5 Drive, Apple FDHD, and Apple Hard Disk 20
Video-Out Port	Supports the connection of external video devices
SCSI Interface	7.5 MB/second transfer rate Supports a maximum of 8 devices (The computer is always device 7. Optional internal SCSI hard disk drive is device 0.)
Apple Desktop Bus	Low-speed serial interface Supports optional low-power mouse
Serial Interfaces	Two RS-232/RS-422 230.4K baud maximum 0.920 Mbit/second if external clock source is provided (modem interface only) Asynchronous, synchronous (modem only), and AppleTalk (printer only) protocols supported Internal connector supports the optional Macintosh Portable Data Modem 2400
Stereo Audio	Stereo compatible Output impedance of 8 to 600 ohms Short-circuit protected Disables internal speaker when in use
Expansion Connector	Processor dependent slot (PDS) 96-pin EuroDIN connector

Environmental

Operating Temperature	10° C to 35° C 50° F to 95° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% noncondensing
Altitude	0 to 10,000 feet 0 to 3048 m

❑ SPECIFICATIONS

Electrical

Main Battery	Type:	Sealed lead-acid
	Voltage:	6.5 volts
	Capacity:	Up to 10 hours (fully charged battery; actual time depends on system configuration and power management settings)
Backup Battery	9-volt transistor	
Power Adapter	AC input voltage:	85–270 volts AC, RMS (100/240 nominal) 48–62 Hz (50/60 nominal)
	Output voltages:	7.0–7.6 volts (7.5 nominal) 5 milliamps–2.0 amps (1.5 nominal)
	Versions available for US, Japan, United Kingdom, Australia, and Europe.	
Battery Recharger (Optional)	Input voltage:	7.5 volts AC
	Output voltage:	6.5 volts DC

Physical

Dimensions (Display Open)	Width	15.25 inches (387.35 mm)
	Height	11.0 inches (279.4 mm)
	Depth	14.83 inches (365.25 mm)
	Height at rear panel	4.05 inches (102.87 mm)
	Height at front panel	2.10 inches (53.34 mm)
Weight (With Battery)	13.75 lbs. (6.25 kg) without hard disk 15.75 lbs. (7.16 kg) with hard disk	
Sound	Apple Sound Chip 1- or 4-voice mono (1 or 2 voices in stereo) with 4-bit digital-to-analog conversion using a 22 KHz sampling rate Filtered by two Sony sound chips	

Programmer's Switch

Figure 11. The programmer's switch can be used to reset the computer, reset the power manager microprocessor, or place the computer in test monitor mode. A sliding lock is provided to prevent accidentally depressing either switch and possibly causing a loss of unsaved information.

- **Reset switch** – Pressing the reset switch will reset the 68HC000 and reboot the computer. Doing so will cause any information in system RAM, including the RAM disk, to be lost.

- **Interrupt switch** – Pressing the interrupt switch will cause the computer to enter the test monitor mode.

- **Reset and interrupt switches together** – Pressing the reset and interrupt switches together will reset the power manager microprocessor. Resetting the power manager can often solve problems with ADB devices, bringing the system out of system sleep, or starting up.

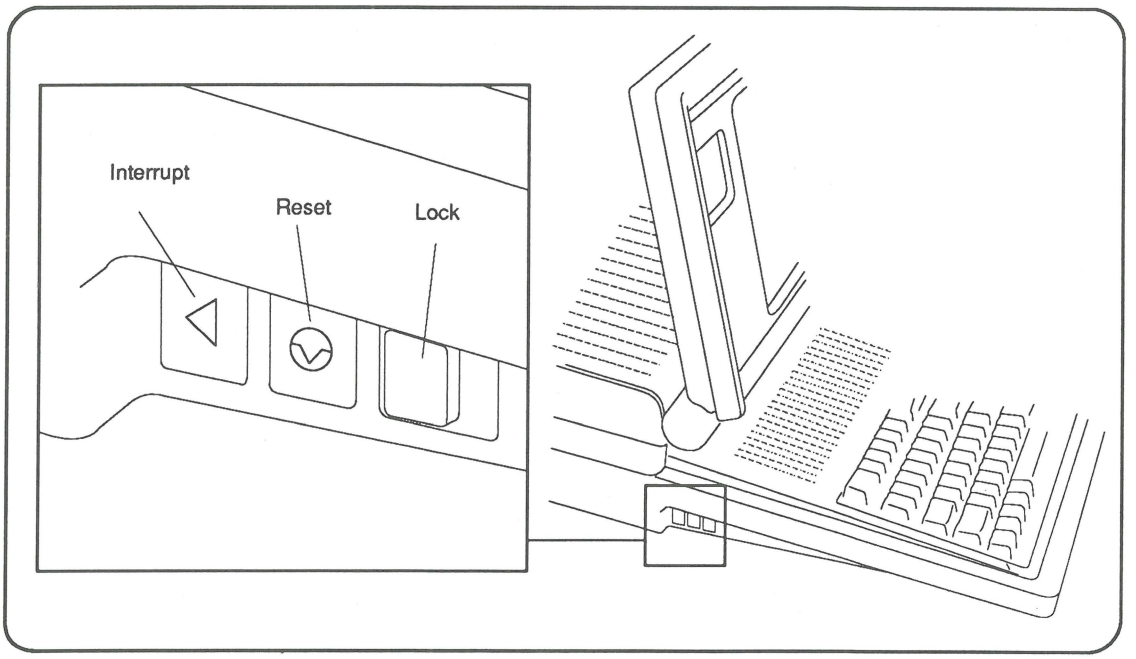


FIGURE 11

❑ OTHER INFORMATION

Materials Required

Figure 12. A minimum of tools are required to maintain and repair the Macintosh Portable computer.

- Flat-blade screwdriver
- 2.44 mm jeweler's screwdriver
- #2 Phillips screwdriver
- Grounded workstation pad
- Grounding wriststrap

Certain procedures require other items such as software or manuals. These items will be indicated where required.

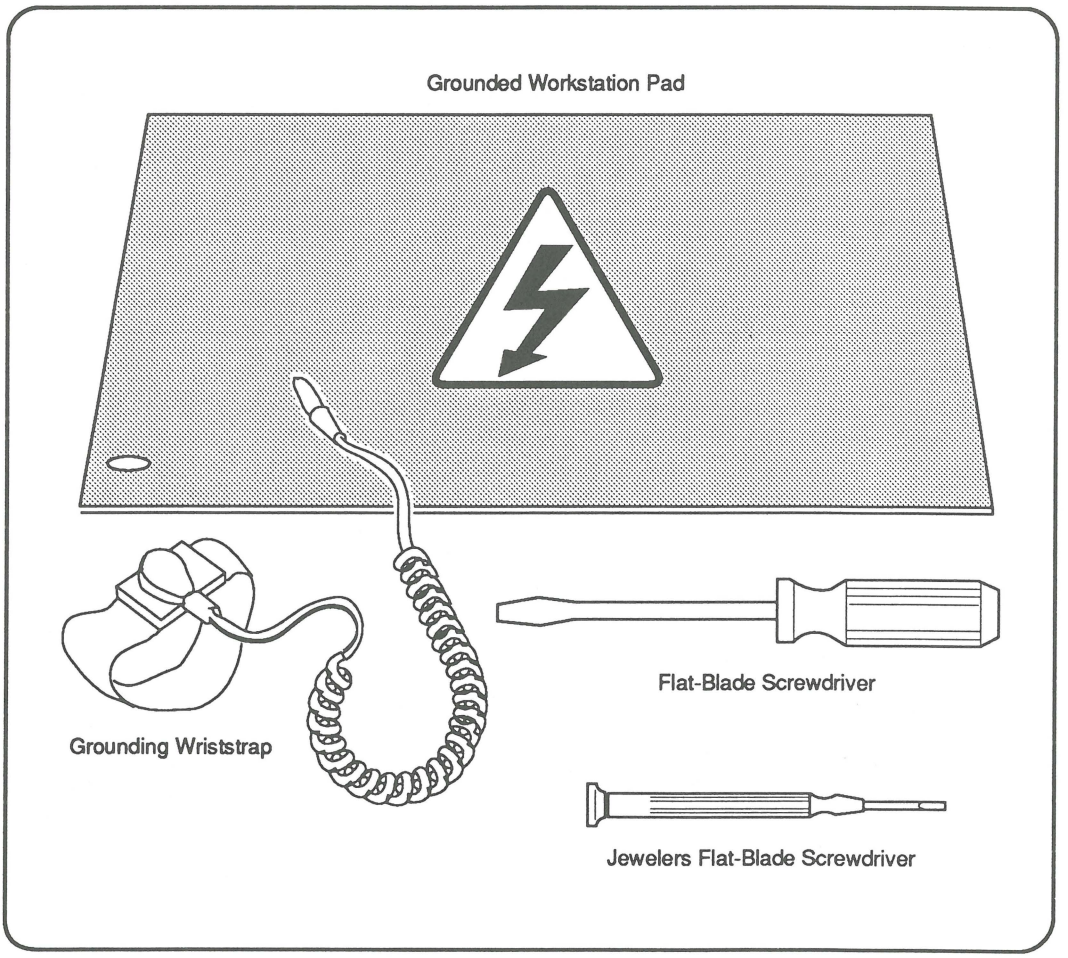


FIGURE 12

Apple Technical Procedures

Macintosh Portable

Section 2 – Take-Apart

❑ CONTENTS

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in this section.

CAUTION: *Be sure to read the "Power Information" section prior to beginning Take-Apart. This section contains important information necessary to preventing possible damage to the Macintosh Portable.*

❑ INTRODUCTION

Materials Required

Flat-blade screwdriver
2.44 mm jeweler's screwdriver
#2 Phillips screwdriver
Needlenose pliers
Grounded workstation pad
Grounding wriststrap

Power Information

Prior to removing or replacing any modules within the Macintosh Portable, you must unplug the power adapter, remove the main battery, and replace the battery cover. By replacing the battery cover you prevent the computer from attempting to operate using the 9-volt battery. **Failure to replace the battery cover can cause damage to the computer.**

CAUTION: *If a RAM disk is present, be sure to save its contents before beginning Take-Apart. Otherwise, the contents of the RAM disk will be lost.*

Battery Disposal

If you are unable to recharge a battery or the battery fails to hold a charge, the battery should be replaced. The old battery is considered toxic waste and must be returned to Apple in the packaging that the replacement battery was shipped in. Apple will dispose of the battery following Environmental Protection Agency (EPA) guidelines.

WARNING: *Do not expose the battery to an open flame, attempt to open the plastic case, or dispose of the battery with other trash.*

Electrostatic Discharge (ESD) Precautions

The Macintosh Portable makes extensive use of low-power complementary metal oxide semiconductor (CMOS) devices. These devices are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you are unwrapping, installing, or replacing modules, observe the appropriate ESD precautions. The protective tape on the component side of the LCD display must not be removed. Complete information on ESD prevention and workstation setup can be found in *You Oughta Know.*

Handling the Bottom Case and Subframe

The bottom case and subframe of the computer have a special coating to reduce electromagnetic interference eminating from the computer. This coating can be damaged by skin oils. Avoid excessive handling of the bottom case and subframe of the computer and, if possible, wash your hands prior to working with these items.

❑ REAR COVER

Remove

1. Place the computer on the grounded workstation mat with the rear panel facing you.

2. **Figure 1-A and 1-B**. Press in the two plastic cover latches at the upper left rear and upper right rear of the computer. Next pivot the rear of the cover up and toward the front of the computer, and lift off the rear cover.

Replace

– **Figure 1-C**. Center the rear cover over the computer, place the front edge in position, and pivot the rear down. Press down on the rear of the cover until it snaps in place.

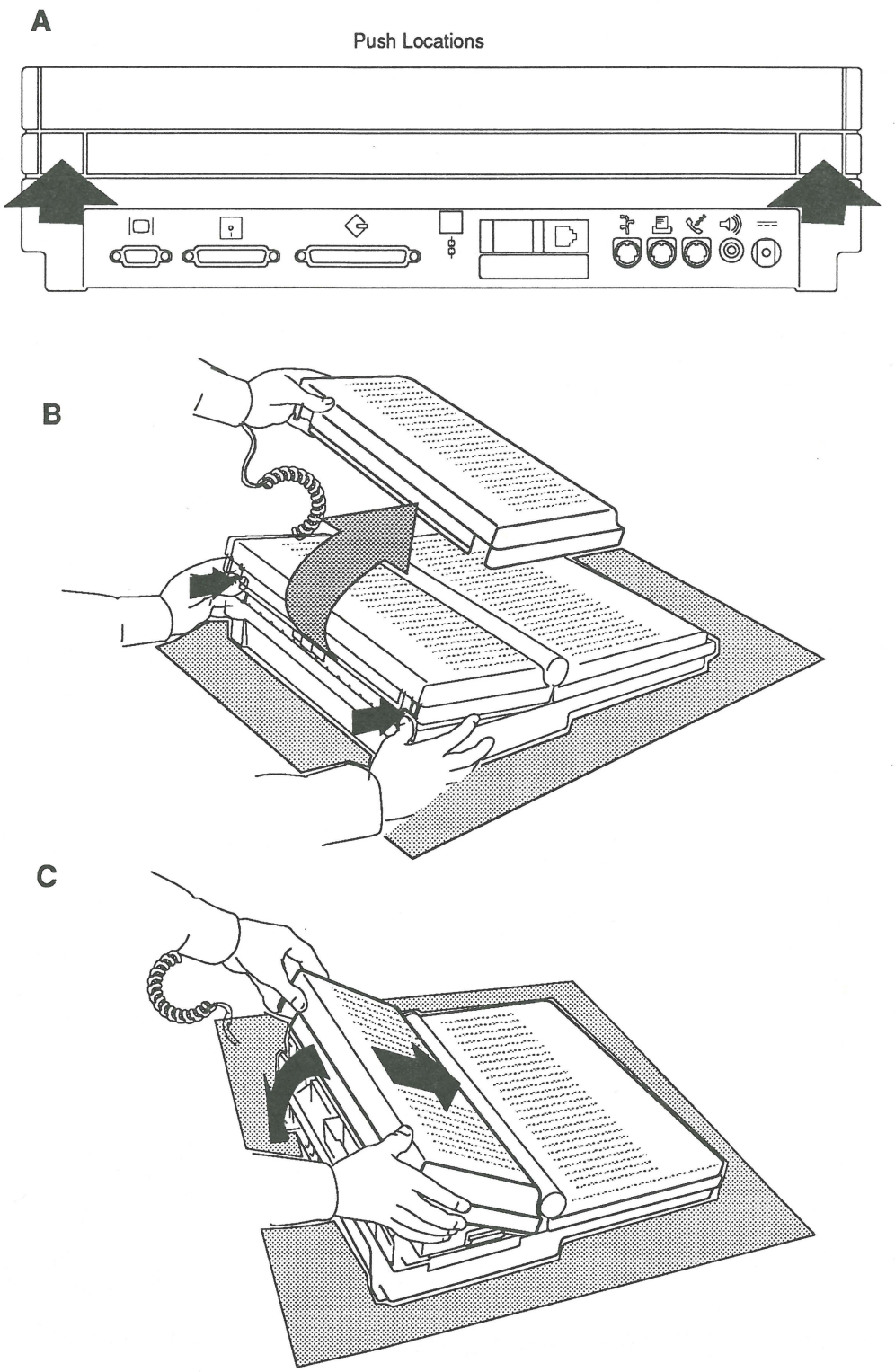


FIGURE 1

❑ KEYBOARD COVER

Remove

1. Open the display by pushing the carrying handle toward the computer and lifting the display.

2. **Figure 2-A**. Position the computer as shown.

3. **Figure 2-A1**. Locate the plastic feet at the top left and top right of the case. Remove each foot by inserting the tip of the screwdriver under the center of the foot and gently lifting the foot away from the case.

4. **Figure 2-A2**. Push the tip of the jeweler's screwdriver into the center hole on the top right of the bottom case. Push the screwdriver down and out until the corner unsnaps.

5. Repeat step 4 for the left side of the cover.

6. Place the computer flat on the grounded workstation pad.

7. **Figure 2-B**. Starting at the edges and working toward the center, slide your index fingers between the bottom case and the keyboard cover until the cover is released.

   Note: Two latches attach the center of the cover to the bottom case, so you'll feel some resistance as you lift the center of the cover. Don't worry—the cover won't break.

Replace

1. **Figure 2-C**. Place the rear edge of the keyboard cover in place and pivot the front of the cover down as shown.

   Note: Make sure the battery wires are flat against the subframe or they may interfere with putting on the cover.

2. Press down on the left corner, right corner, and center of the cover until it snaps in place.

3. **Figure 2-A**. Place the unit back in the position shown and replace the rubber feet.

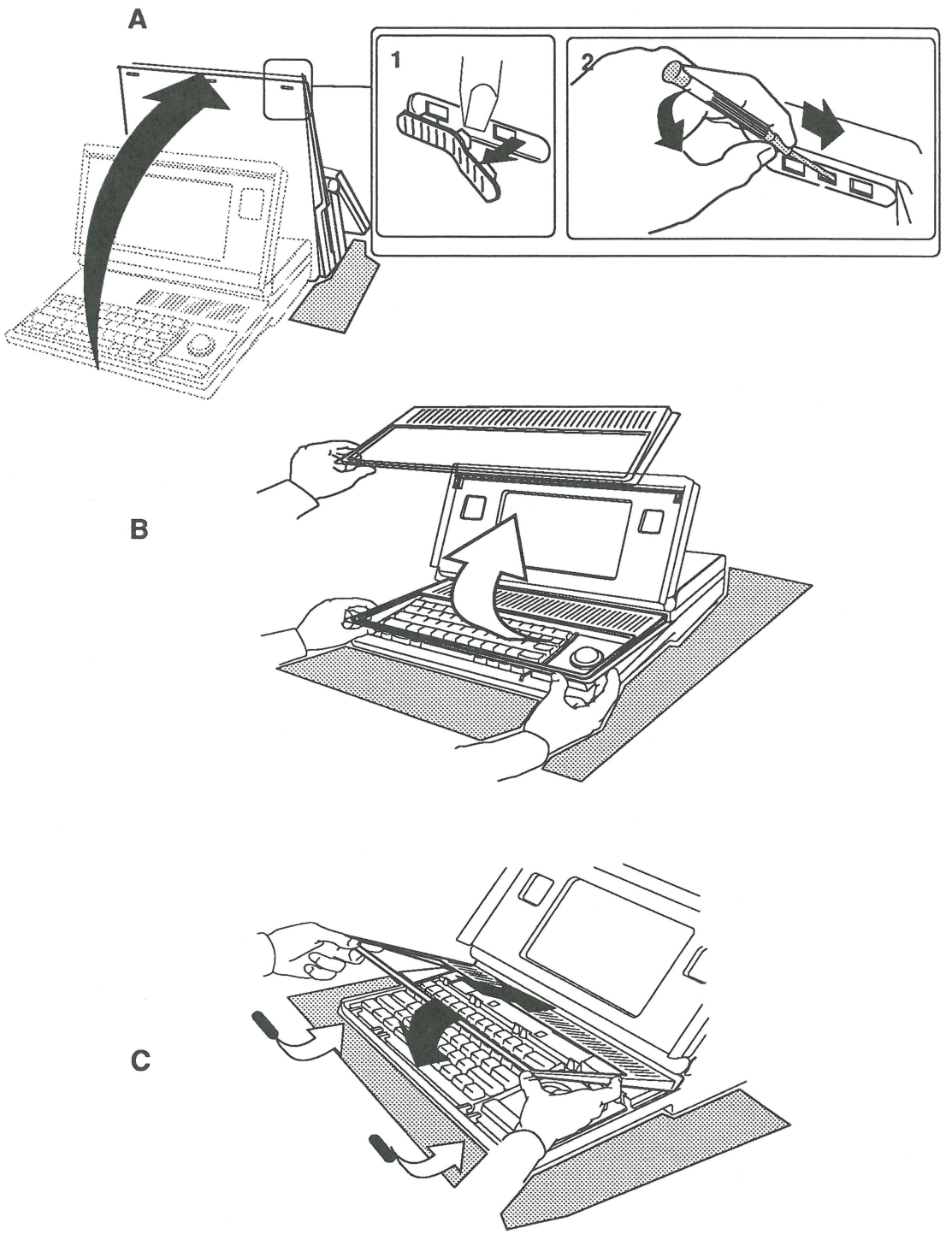


FIGURE 2

❑ MAIN BATTERY

Remove

1. Remove the rear cover.
2. **Figure 3-A.** Press down on the two plastic tabs at the front of the battery cover and slide the battery cover toward the rear of the computer.
3. **Figure 3-B.** Lift off the battery cover.
4. **Figure 3-C.** Lift out the main battery.
5. **Figures 3-D, 3-E, and 3-F. If you are doing anything other than replacing the main battery**, replace the battery cover by placing the battery cover on the battery compartment and sliding it evenly toward the front of the computer until it snaps in place.

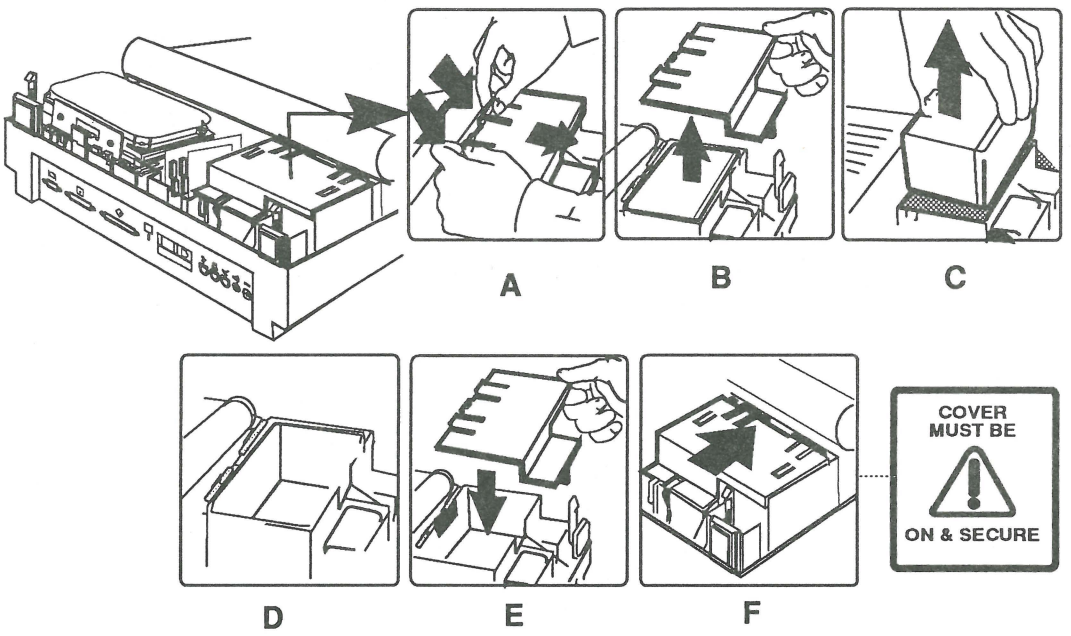
CAUTION: *Replacing the battery cover with the main battery removed disconnects the backup battery. Failure to put the battery cover on leaves power connected to the logic board. Removing and replacing modules with power available could cause damage to any module.*

Replace

1. **Figures 3-G and 3-H.** If the battery cover is on, remove it.
2. **Figures 3-I and 3-J.** Place the battery into the battery compartment. The tab on the battery should be facing toward the front of the computer.
3. **Figures 3-K and 3-L.** Place the battery cover on the battery compartment and slide it evenly toward the front of the computer until it snaps in place.
4. Replace the rear cover.

CAUTION: *The Macintosh Portable main battery is a sealed, lead acid battery that also contains toxic materials (lead and sulfuric acid). Send the Macintosh Portable main battery to Apple for proper disposal. Return those batteries that are not physically damaged in the same packaging that new batteries were received. If the lead batteries are damaged, do not return them to Apple. Instead dispose of them according to your local ordinances.*

REMOVE



REPLACE

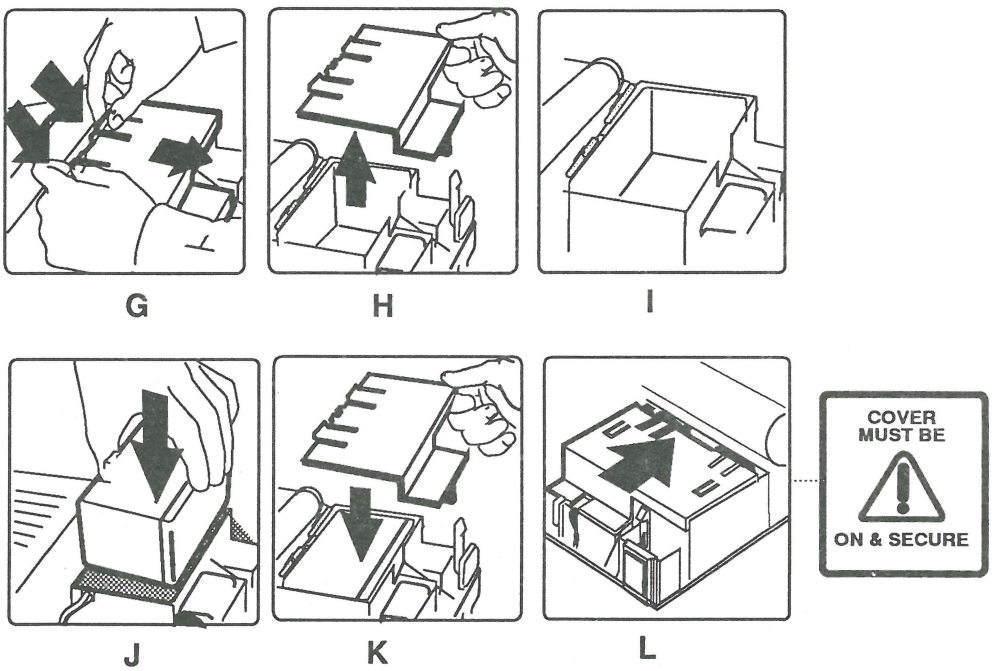


FIGURE 3

❑ BACKUP BATTERY

Note: Removing the backup battery will erase the contents of parameter RAM. Before beginning this procedure, be sure to note all the Control Panel settings so they can be restored upon completion of your repairs. If you are unsure how to use the Control Panel desk accessory to modify these settings, refer to the *Macintosh Portable Owner's Guide.*

Remove

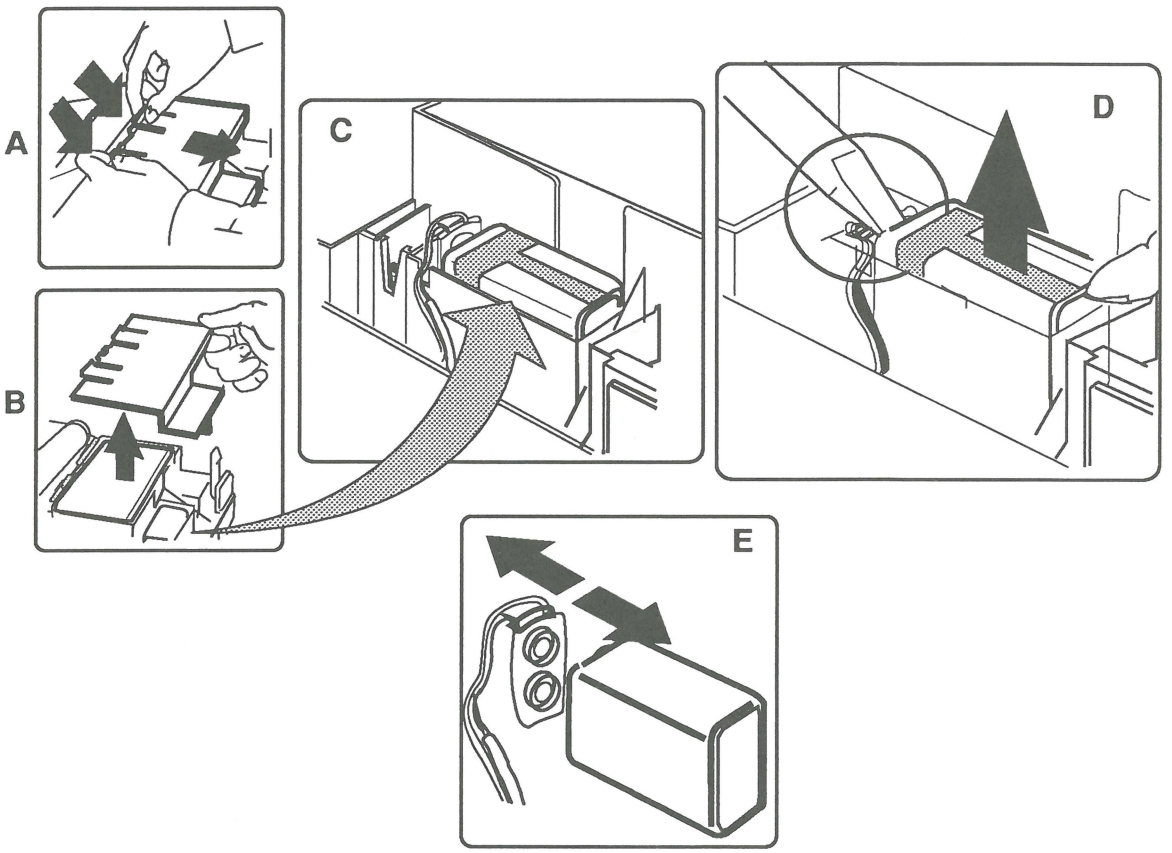
1. Remove the rear cover.
2. **Figure 4-A.** Press down on the two plastic tabs at the front of the battery cover and slide the battery cover toward the rear of the computer.
3. **Figure 4-B.** Lift the battery cover off.
4. **Figure 4-C.** Locate the backup battery. **Figure 4-D.** Use the tip of the jeweler's screwdriver to lift the edge of the backup battery far enough to grab the battery with your fingers and remove the battery from its compartment.
5. **Figure 4-E.** Disconnect the battery cable from the battery.

Replace

1. **Figure 4-F.** Connect the battery cable to the battery.
2. **Figure 4-G.** Place the battery into the battery compartment. The battery cable should be at the left side of the compartment.

   Note: **Figure 4-G.** Make sure the backup battery wires are well seated in the slot in the battery compartment and are not being pinched when the battery cover is on.
3. **Figure 4-H and 4-I.** Place the battery cover on the battery compartment and slide it evenly toward the front of the computer until it snaps in place.
4. Replace the rear cover.

REMOVE



REPLACE

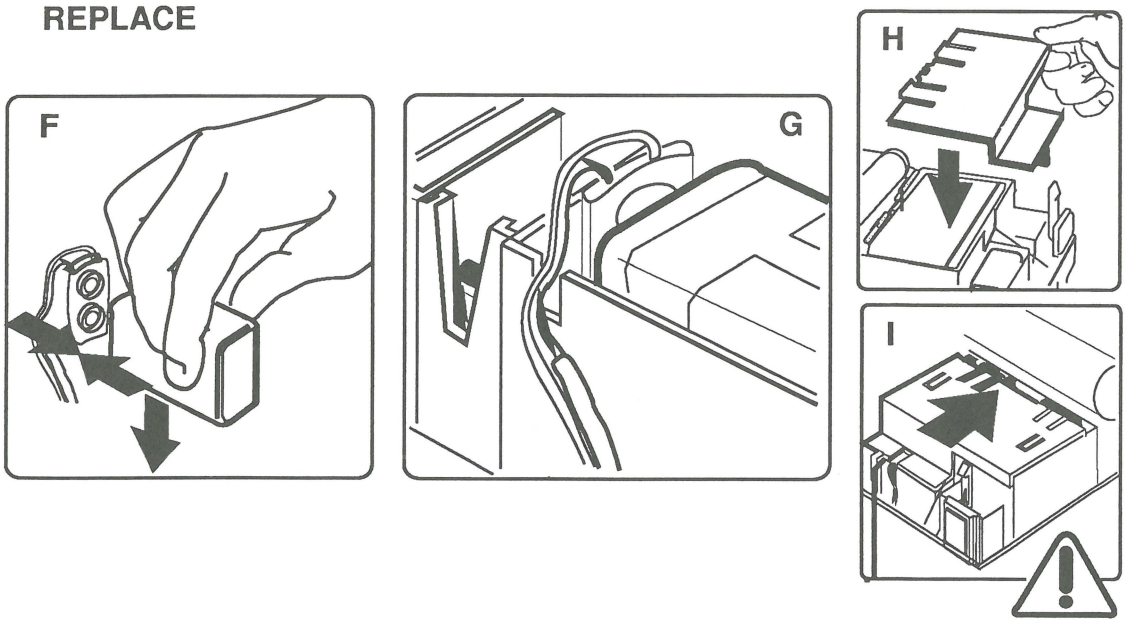


FIGURE 4

❑ OPTION CARDS

Remove

1. Remove the rear cover and main battery.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove or replace any option cards. Failure to replace the battery cover can damage the computer.*

2. **Figure 5-A**. Using the figure as a guide, locate the option card you wish to remove.

3. **Figure 5-B**. Lift the card straight up and out of the computer.

   Note: To reduce the possibility of ESD damage, handle the card only by the edges.

Replace

1. **Figure 5-A**. Using the figure as a guide, determine which connector to install the option card in.

CAUTION: *If you are installing a RAM expansion card, the 1 MB static and 1 MB and 3 MB pseudostatic cards are not interchangeable. Identification information can be found in Section 1, Basics, "Options."*

2. **Figure 5-C**. Position the option card over the correct connector and plug the card in.

3. Replace the main battery and rear cover.

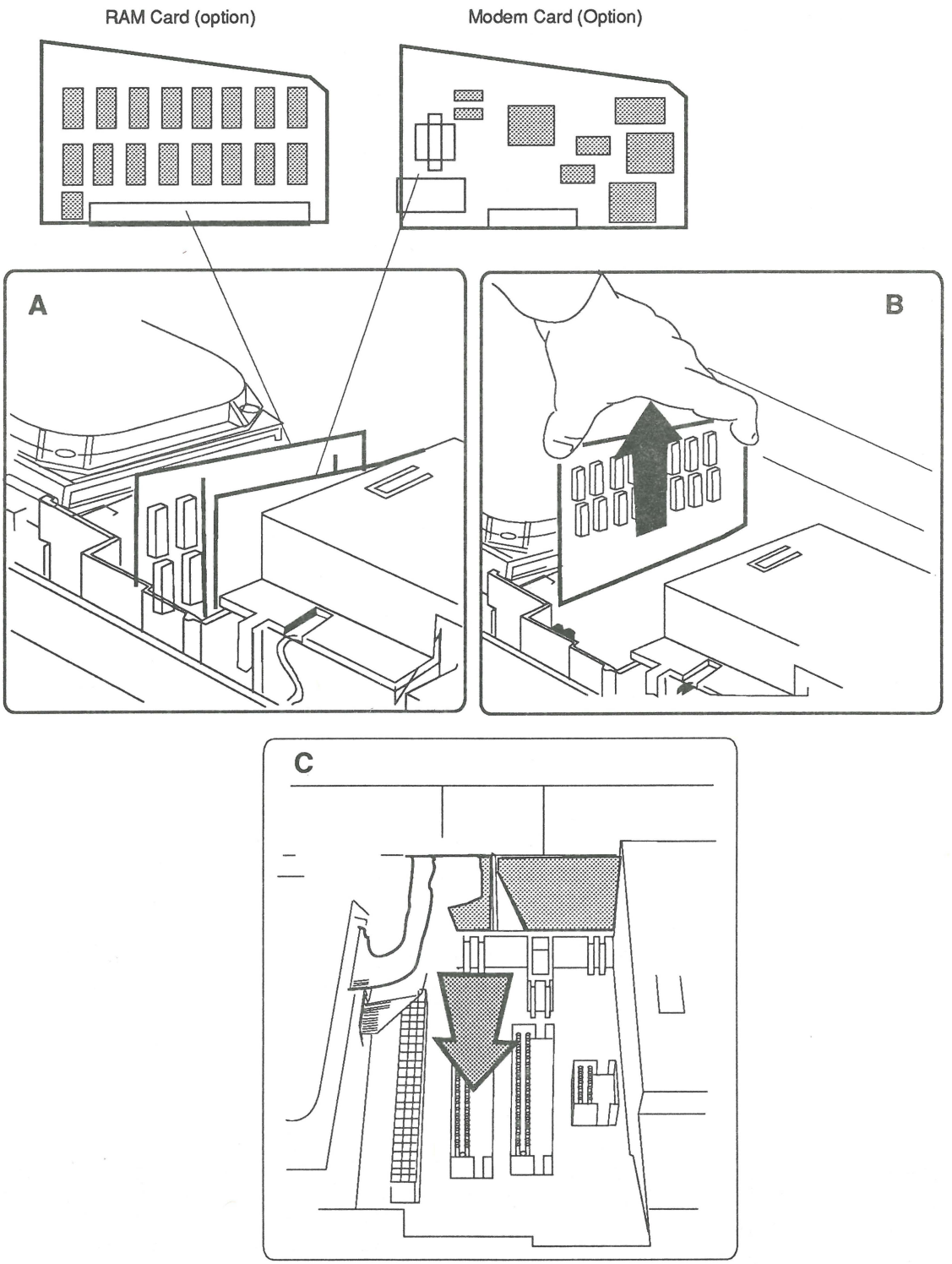


FIGURE 5

❑ SCSI HARD DISK DRIVE

Remove

1. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. Remove all option cards installed.

3. **Figures 6-A and 6-B.** Disconnect the display and hard disk drive cables from logic board connectors J19 and J18.

4. **Figure 6-C.** Close the display and slide the disk drive cable out toward the rear of the computer.

5. **Figure 6-D and 6-E.** Unsnap the plastic latches at the front and rear of the hard disk drive. Lift up and remove the hard disk from the subframe.

CAUTION: *DO NOT loosen or remove any of the screws that attach the hard drive to the drive shield. Doing so can cause irreparable hard drive damage.*

Replace

1. If the display is open, close it.

2. **Figure 6-F.** Lower the hard drive into the subframe, align the four metal tabs, and press down until the plastic latches at the front and rear snap in place.

CAUTION

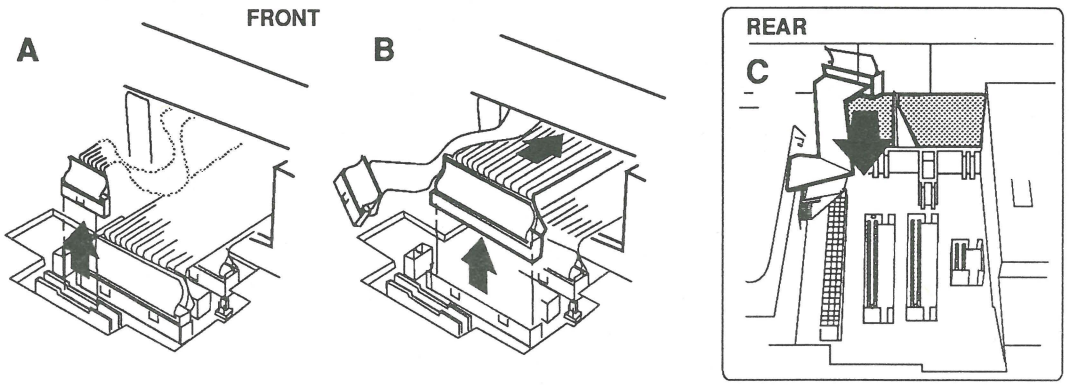
CAUTION: *Make sure the disk drive cable does not get caught under the disk drive shield. Otherwise, the cable could be damaged.*

3. **Figure 6-G.** Slide the hard disk drive cable through the opening under the display assembly.

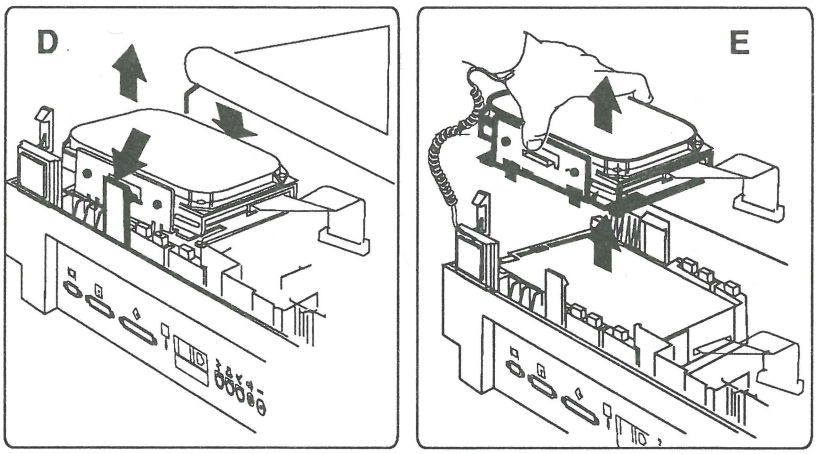
4. **Figure 6-H and 6-I.** Connect the hard drive cable and display cable to logic board connectors J18 and J19.

5. Replace any option cards removed.

6. Replace the keyboard cover, main battery, and rear cover.



REMOVE



REPLACE

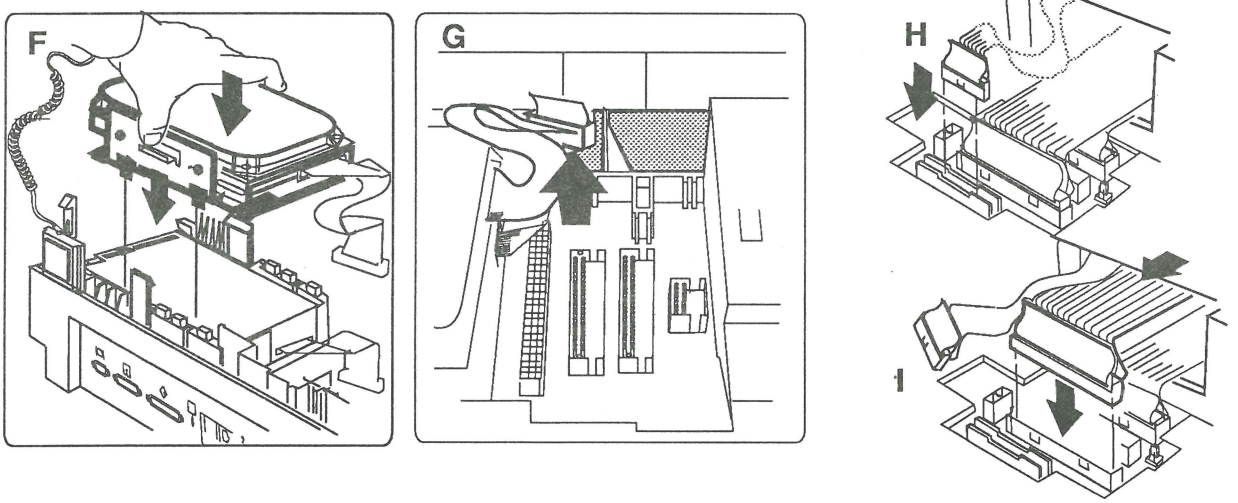


FIGURE 6

❑ UPPER FLOPPY DISK DRIVE

Remove

1. Remove the rear cover and main battery.

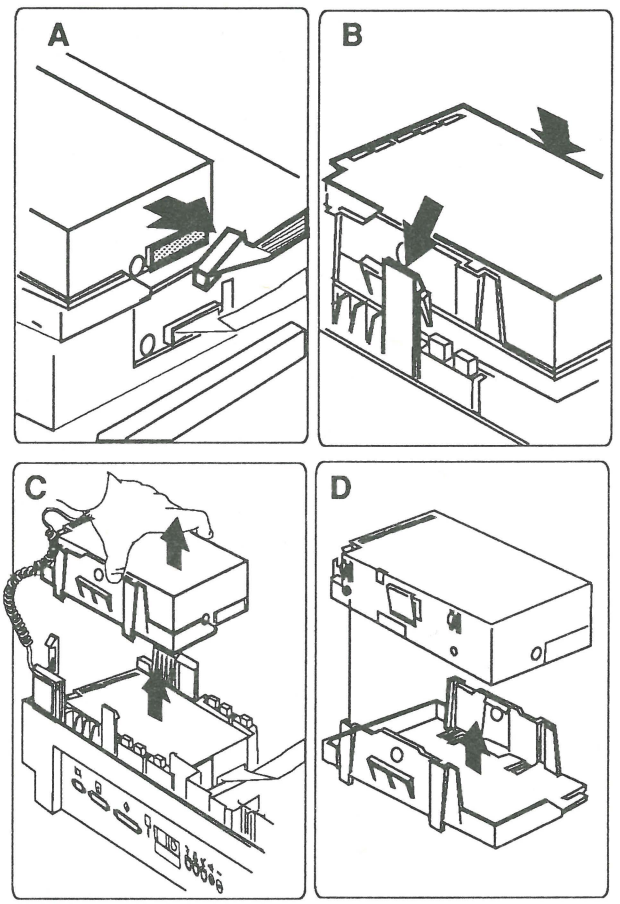
CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove any modules. Failure to replace the battery cover can damage the computer.*

2. Remove any option cards installed.
3. **Figure 7-A.** Disconnect the floppy disk drive cable from the disk drive.
4. **Figure 7-B and 7-C.** Unsnap the plastic latches at the front and rear of the disk drive and lift up and remove the disk drive.
5. **Figure 7-D.** Remove the floppy drive mechanism from the floppy retainer by depressing the two metal tabs at the sides of the unit.

Replace

1. **Figure 7-E.** Place the floppy drive mechanism into the floppy retainer.
2. **Figure 7-F.** Lower the disk drive into the subframe, align the four metal tabs, and press down until the plastic latches at the front and rear snap in place.
3. **Figure 7-G.** Connect the floppy disk drive cable to the disk drive.
4. Replace any option cards removed.
5. Replace the main battery and rear cover.

REMOVE



REPLACE

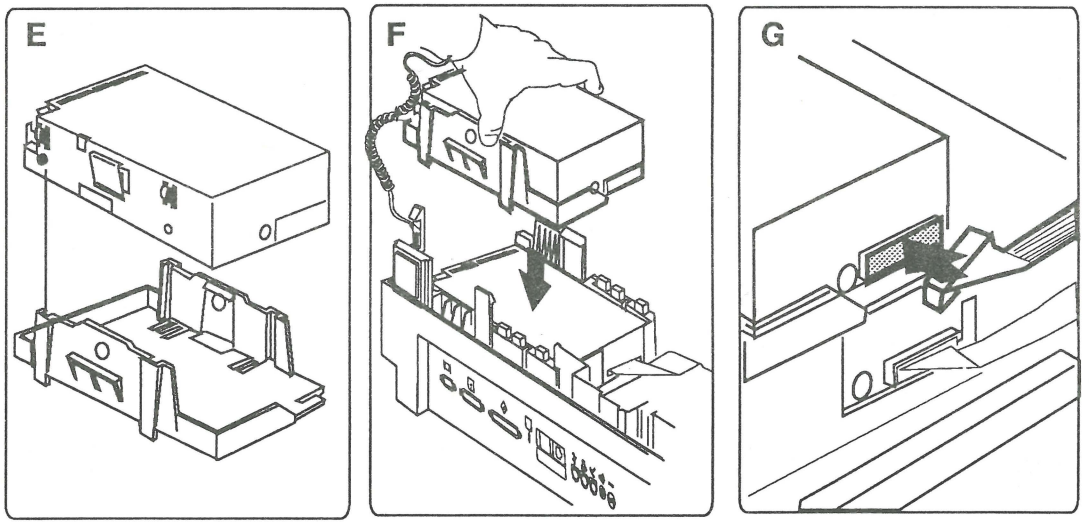


FIGURE 7

❑ LOWER FLOPPY DISK DRIVE

Remove

1. Remove the rear cover and main battery.

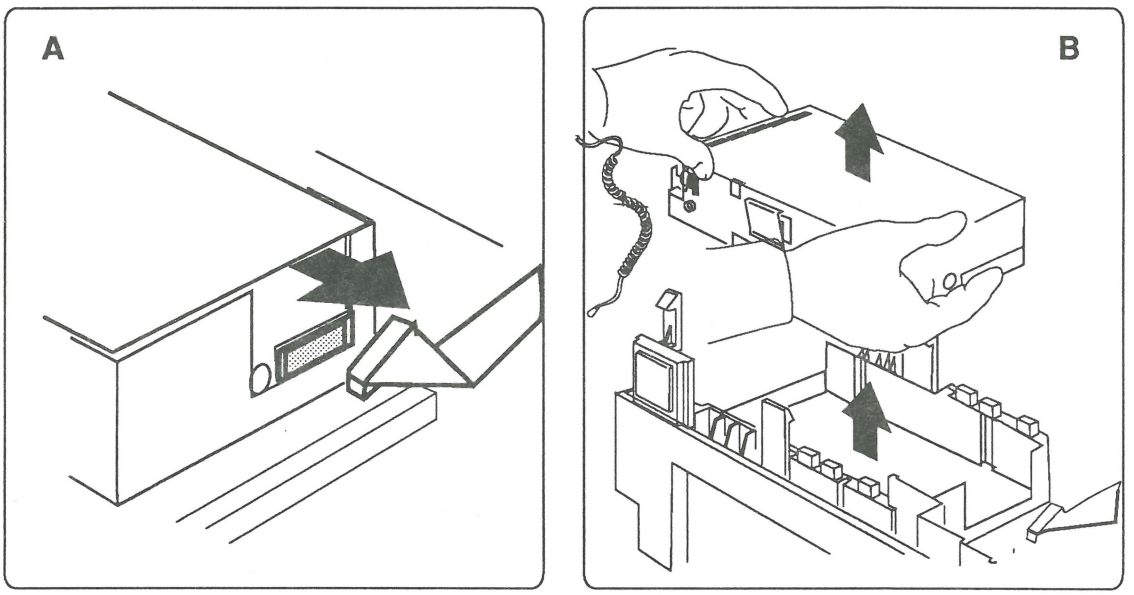
CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. Remove any option cards installed.
3. Remove the upper floppy disk drive or SCSI hard disk, if installed.
4. **Figure 8-A.** Disconnect the disk drive cable from the disk drive.
5. **Figure 8-B.** Lift the disk drive up and out of the subframe.

Replace

1. **Figure 8-C.** Place the disk drive in the subframe.
2. **Figure 8-D.** Connect the disk drive cable.
3. Replace the upper floppy disk drive or SCSI hard disk drive, if removed.
4. Replace any option cards removed.
5. Replace the main battery and rear cover.

REMOVE



REPLACE

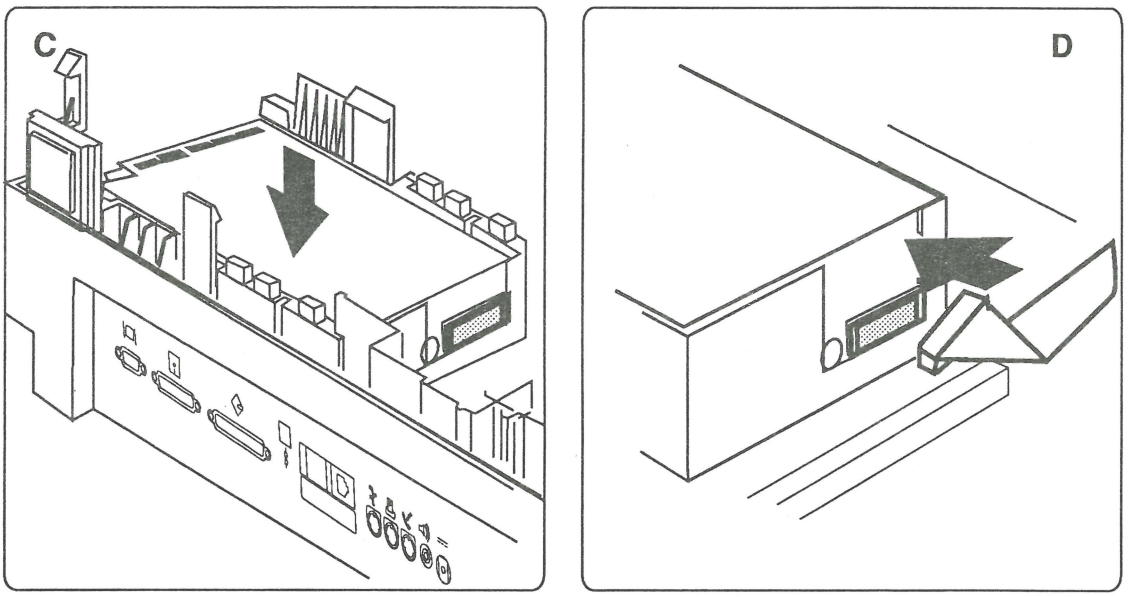


FIGURE 8

❑ KEYBOARD, TRACKBALL, AND NUMERIC KEYPAD

The following procedures cover removing and replacing the keyboard, trackball, and optional numeric keypad. The procedures assume the standard configuration—keyboard on the right and trackball on the left. The system you're working on may have the devices reversed or may have a numeric keypad substituted for the trackball.

Remove

1. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. **Figures 9-A1, 9-A2, and 9-A3.** Disconnect the flat cable from the device to be removed. The figures show the cable locations.

3. **Figures 9-B1, 9-B2, and 9B-3.** Starting at one side of the device, simultaneously press back on each plastic tab securing the device to the case and lift the device. The figures show the tab locations.

4. **Figures 9-C1, 9-C2, and 9-C3.** After all the tabs have been released, remove the device from the computer.

Replace

1. **Figures 9D-1, 9D-2, and 9D-3.** Place the front of the device in the guides at the front of the computer. Press down the rear of the device until it snaps in place.

2. **Figures 9E-1, 9E-2, and 9E-3.** Connect the flat cable to the device.

3. Replace the keyboard cover, main battery, and rear cover.

KEYBOARD, TRACKBALL, AND NUMERIC KEYPAD ❑

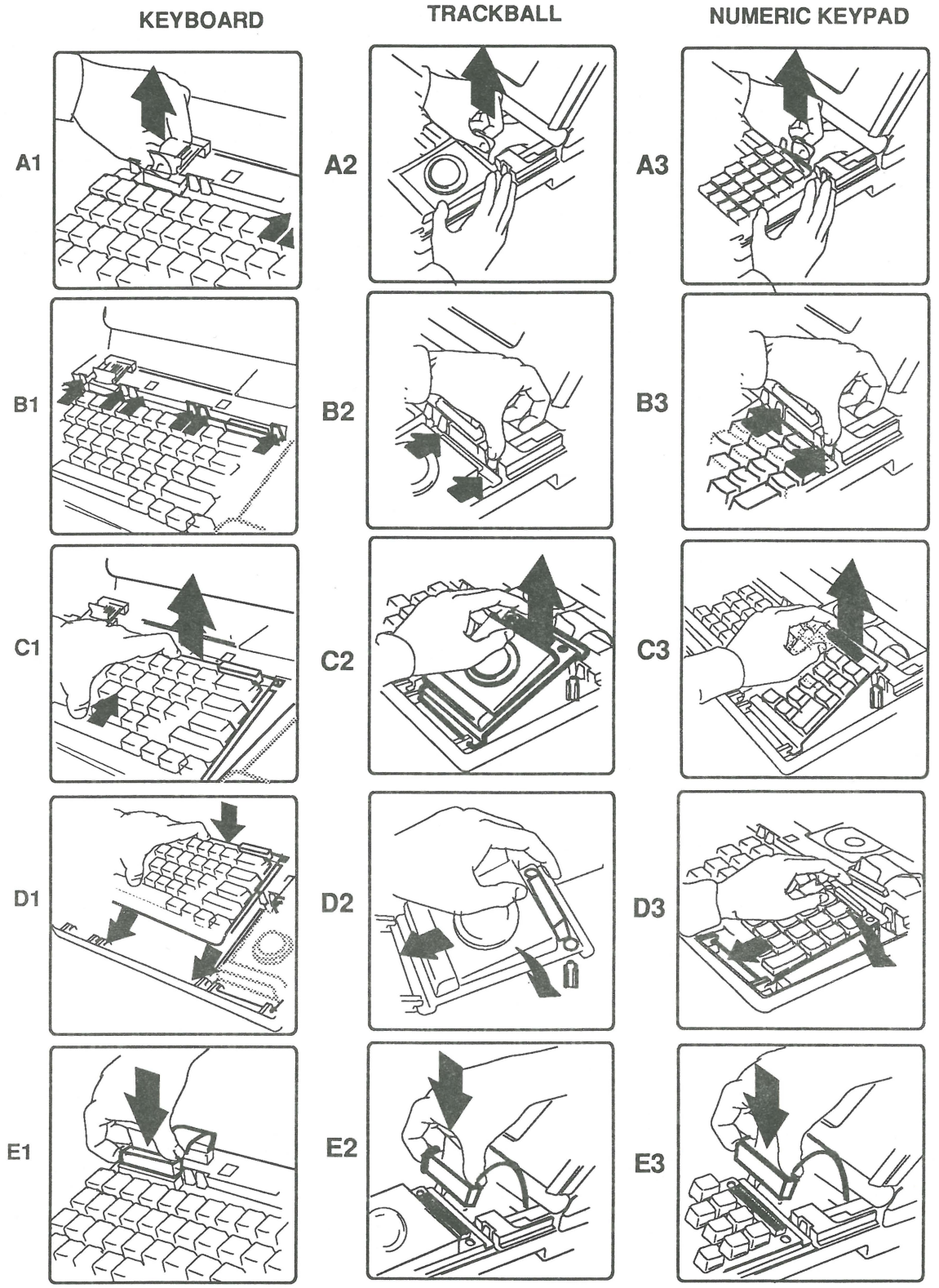


FIGURE 9

❑ SPEAKER

Remove


CAUTION

1. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. **Figure 10-A.** Disconnect the speaker cable from logic board connector J16.

3. **Figure 10-A.** Simultaneously press the two plastic tabs away from the speaker and lift the speaker from the subframe.

Replace

1. **Figure 10-B.** Place the speaker in position over its four positioning posts and snap the speaker in place.

2. **Figure 10-C.** Connect the speaker cable to logic board connector J16.

3. Replace the keyboard cover, main battery, and rear cover.

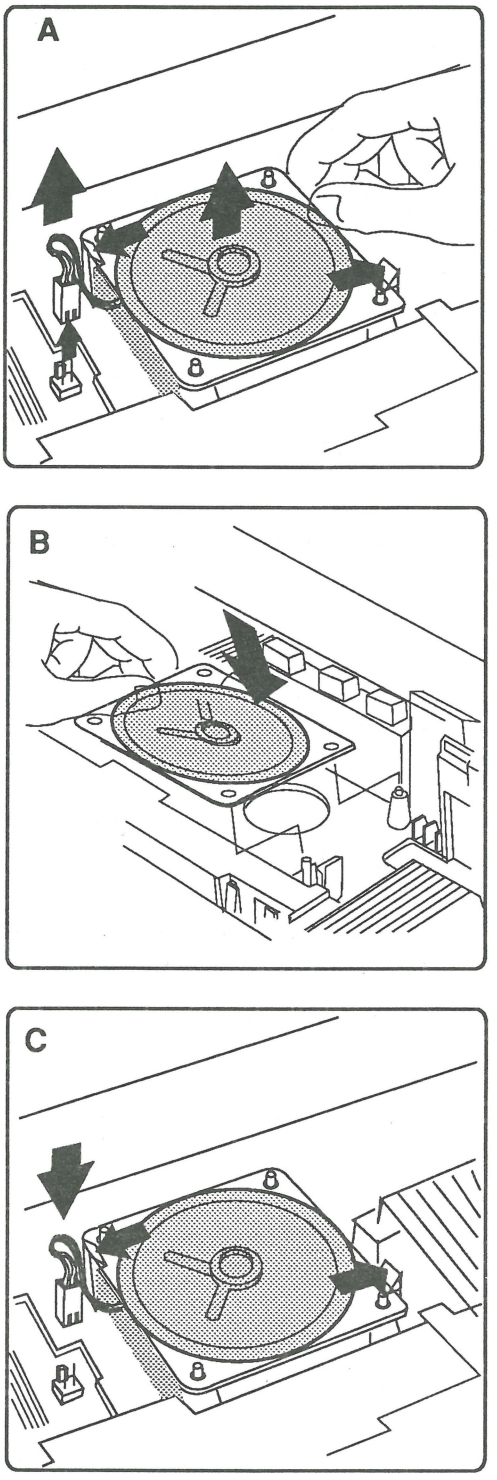


FIGURE 10

❑ DISPLAY ASSEMBLY

Remove

1. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. **Figure 11-A**. Disconnect the display cable from logic board connector J19.

3. **Figure 11-B**. Remove the left clutch cover by simultaneously gently twisting the cover back and forth and pulling the cover away from the display.

4. **Figure 11-C**. Lift up and remove the left clutch retainer.

5. **Figure 11-D**. Place your hands on either side of the display assembly. Push the display assembly to the left with your right hand while maintaining a slight pressure on the display with your left.

6. **Figure 11-E**. Remove the left clutch mechanism from the display.

7. Slide the display assembly up and to the left and disengage it from the right clutch mechanism.

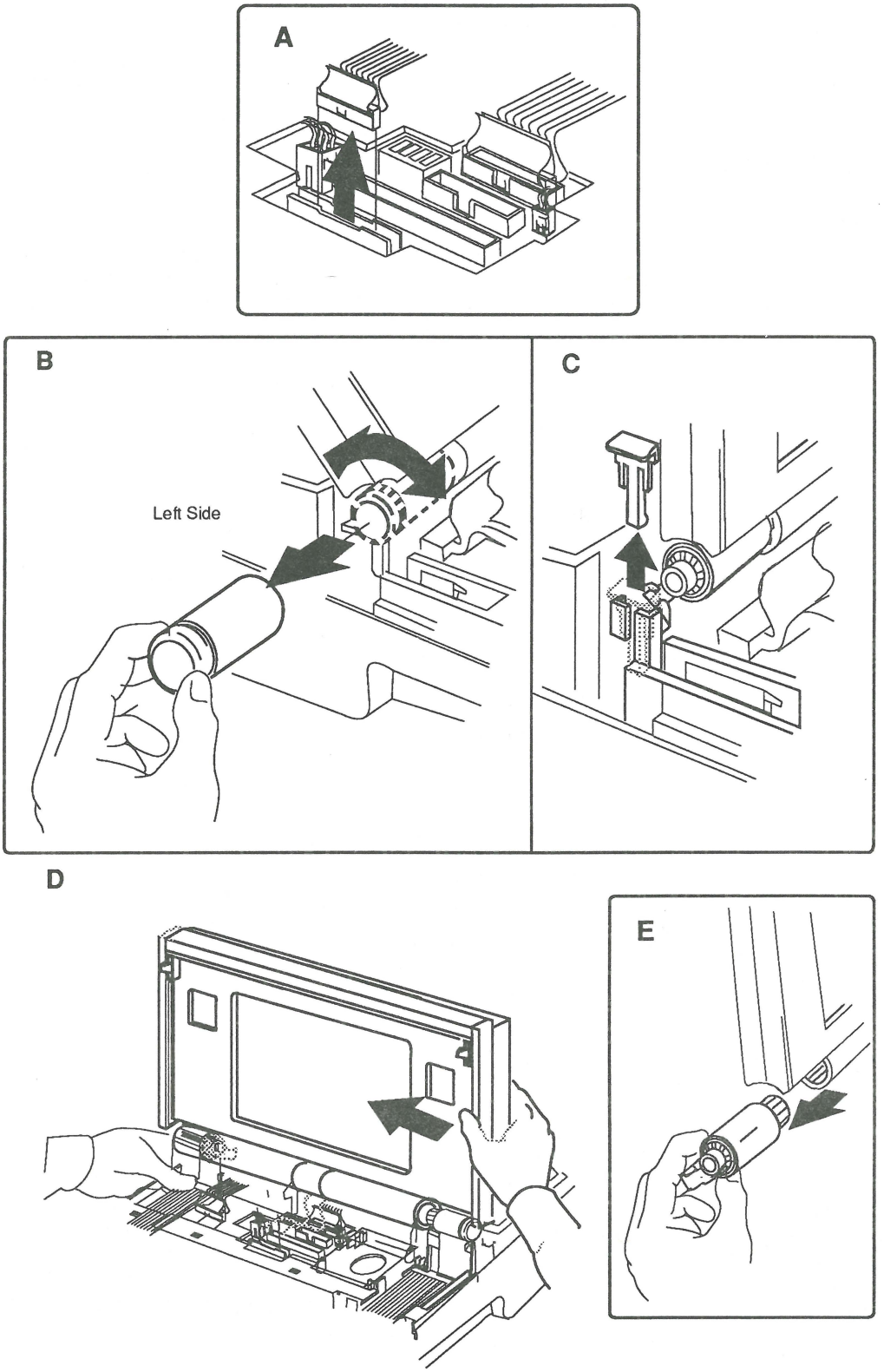


FIGURE 11

❑ DISPLAY ASSEMBLY

Replace

1. **Figure 12-A**. Hold the display assembly upright and slide the assembly onto the right clutch mechanism. Note that the ridges in the clutch must mate with the grooves in the display housing.

   Note: Make sure the display cable is to the right of the subframe upright.

2. **Figure 12-B**. While still holding the display assembly upright, slide the left clutch mechanism into place. Again the ridges in the clutch must mate with the grooves in the housing.

3. **Figure 12-C**. Slide the left clutch retainer into position.

4. **Figure 12-D**. Replace the left clutch cover.

5. **Figure 12-E**. Connect the display cable to logic board connector J19.

6. Replace the keyboard cover, main battery, and rear cover.

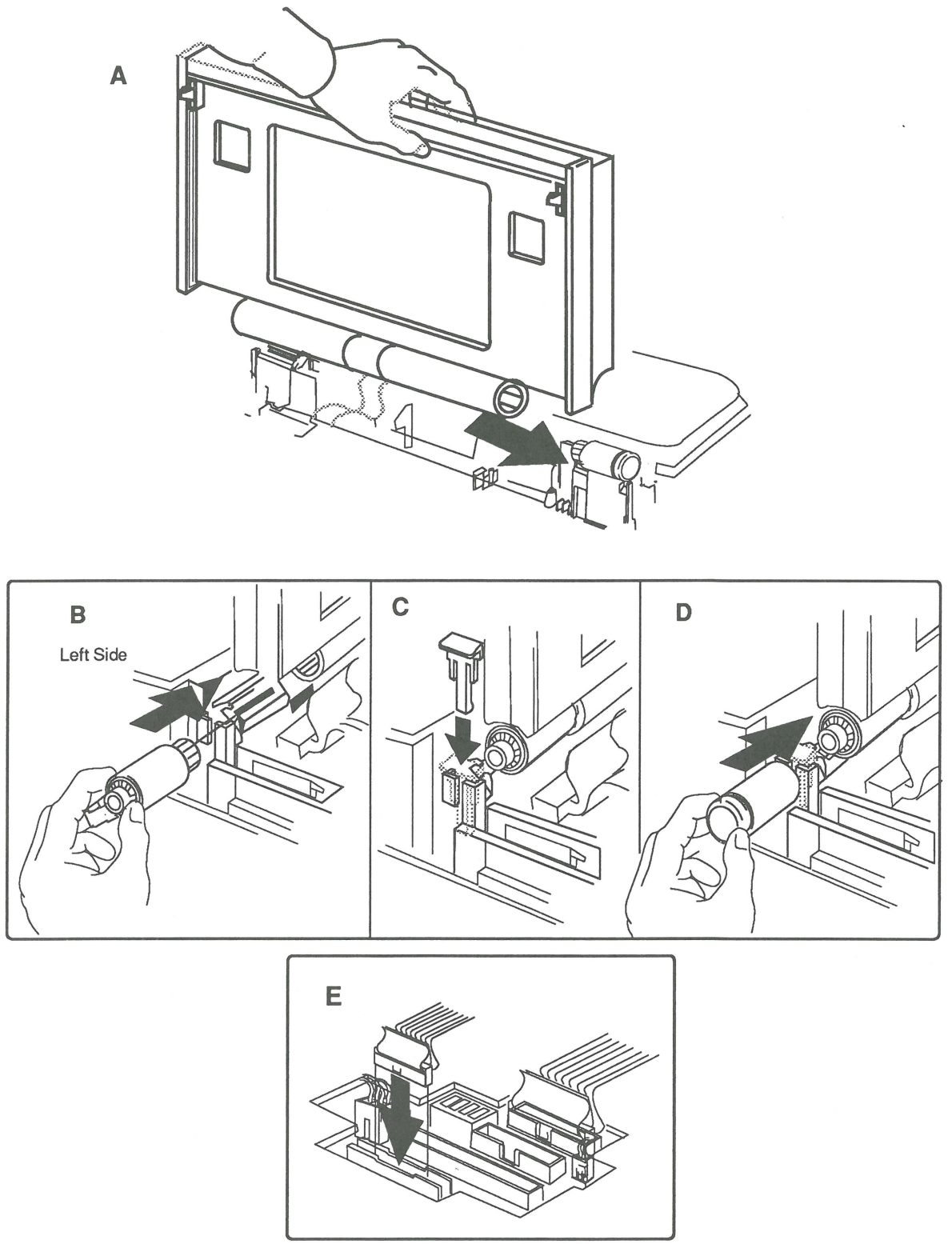


FIGURE 12

❑ LCD DISPLAY (NONBACKLIT)

CAUTION: *The LCD display is extremely susceptible to ESD damage. As always, make sure you are using a grounded workstation pad and grounding wriststrap when handling sensitive electronics. Handle the display only by the edges and DO NOT touch the component side or remove any of the tape.*

Remove

1. Remove the rear cover, main battery, keyboard cover, and display assembly and place the display assembly on the workstation pad display-side-up.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. **Figure 13-A**. Slide the carrying handle away from the display to its fully extended position.

   Note: Later-model Portables and replacement display assembly plastics have two Phillips screws securing the bezel to the housing. Perform step 3 if the Portable you are working on has these screws. Otherwise, go to step 4.

3. **Figure 13-B**. Remove the two Phillips screws at the upper-right and upper-left corners of the display bezel.

4. **Figure 13-C**. Remove the center pivot cover by turning the opening of the cover toward the display and then pulling the center pivot cover away from the display housing.

5. **Figure 13-D**. Release the right side of the display bezel by inserting the jeweler's screwdriver into the display latch opening on the left side of the display housing as shown in the inset of Figure 13-D. Hold the screwdriver with your right hand and place your left hand on the display as shown in the illustration. Push the screwdriver into the opening until you hear a click and then pull the display bezel toward you with your index and middle fingers while pushing the display housing with your thumb. The two parts separate about 1/8 inch.

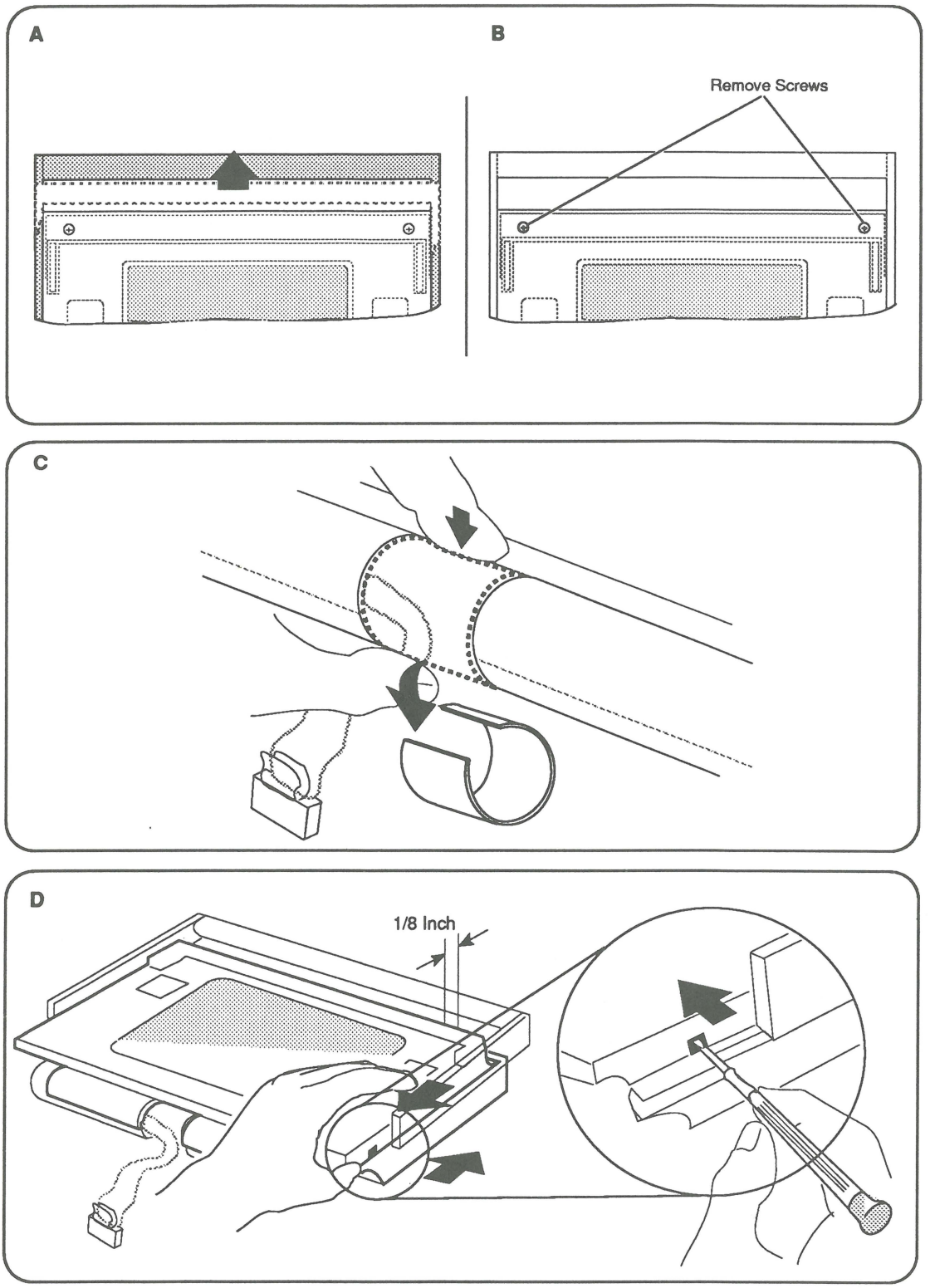


FIGURE 13

❑ LCD DISPLAY (NONBACKLIT)

6. Repeat step 5 for the left side. This time, however, hold the screwdriver with your left hand and move the display bezel and housing with your right.

7. **Figure 14-A**. Lift the display bezel and carrying handle off the display housing.

8. **Figure 14-B**. Simultaneously pull the two plastic clips at the upper-left and upper-right sides of the display away from the display with your thumbs and lift up the display with your index fingers.

9. **Figure 14-C**. Slide the display up and out of the housing.

10. **Figure 14-D**. Disconnect the display cable.

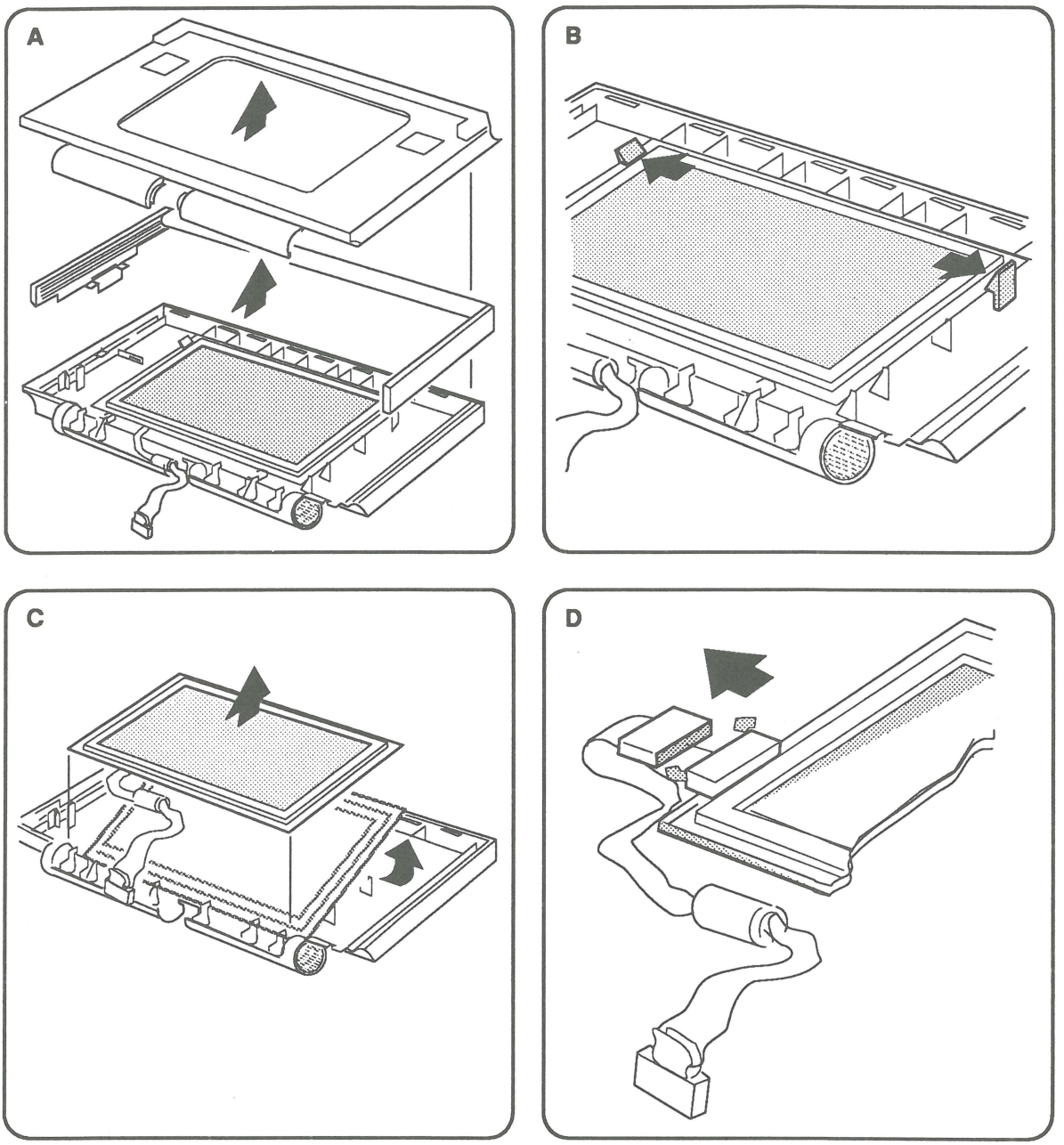


FIGURE 14

❑ LCD DISPLAY (NONBACKLIT)

Note: Three sets of display housings and bezels exist for the Portable. These plastics are functionally equivalent—however, they must be used as sets. **Figure 15-A** illustrates these differences and the correct combinations.

Replace

1. **Figure 15-B**. Connect the display cable to the display.

2. **Figure 15-C1**. Place the bottom edge of the display into the two plastic clips at the bottom of the display housing.

   Note: **Figure 15-C2**. Make sure the display cable is placed as shown. The cable must lie flat under the display, and the cable and ferrite bead must be carefully placed in the channel.

3. **Figure 15-C3**. Press down on the corners of the display with your thumbs until it snaps in place.

4. Peel the protective plastic sheet from the display.

5. **Figures 15-D1**. Place the carrying handle in position in the display housing. The plastic clips should be in the channel at the edge of the housing.

6. **Figure 15-D2**. Place the display bezel on the housing as shown in the illustration. You'll need to hold the carrying handle in position.

7. **Figure 15-E**. Slide the bezel evenly toward the top of the housing as shown in the illustration.

8. **Figure 15-E**. If screw holes are present, replace the two Phillips screws at the upper-right and upper-left corners of the display bezel.

9. **Figure 15-F**. Snap the center pivot cover back on the display pivot as shown in the illustration.

10. Replace the display assembly, keyboard cover, main battery, and rear cover.

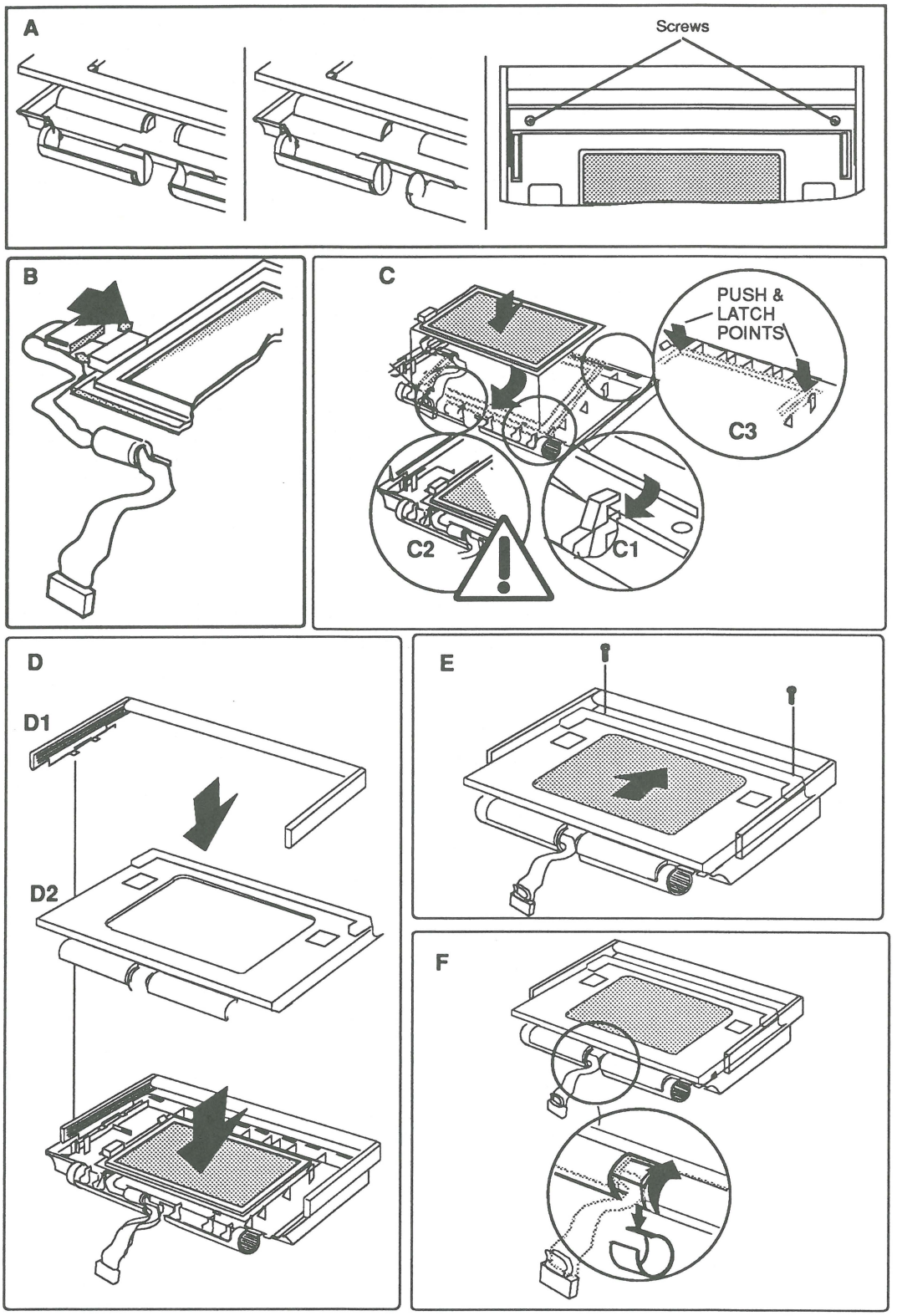


FIGURE 15

❑ LCD DISPLAY (BACKLIT)

CAUTION: *The LCD display is extremely susceptible to ESD damage. As always, make sure you are using a grounded workstation pad and grounding wriststrap when handling sensitive electronics. Handle the display only by the edges and DO NOT touch the component side or remove any of the tape.*

Remove

1. Remove the rear cover, main battery, keyboard cover, and display assembly and place the display assembly on the workstation pad display-side-up.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. **Figure 16-A**. Slide the carrying handle away from the display to its fully extended position.

3. **Figure 16-B**. Remove the two Phillips screws at the upper-right and upper-left corners of the display bezel.

4. **Figure 16-C**. Remove the center pivot cover by turning the opening of the cover toward the display and then pulling the center pivot cover away from the display housing.

5. **Figure 16-D**. Release the right side of the display bezel by inserting the jeweler's screwdriver into the display latch opening on the left side of the display housing as shown in Figure 16-D. Hold the screwdriver with your right hand and place your left hand on the display as shown in the illustration. Push the screwdriver into the opening until you hear a click and then pull the display bezel toward you with your index and middle fingers while pushing the display housing with your thumb. The two parts separate about 1/8 inch.

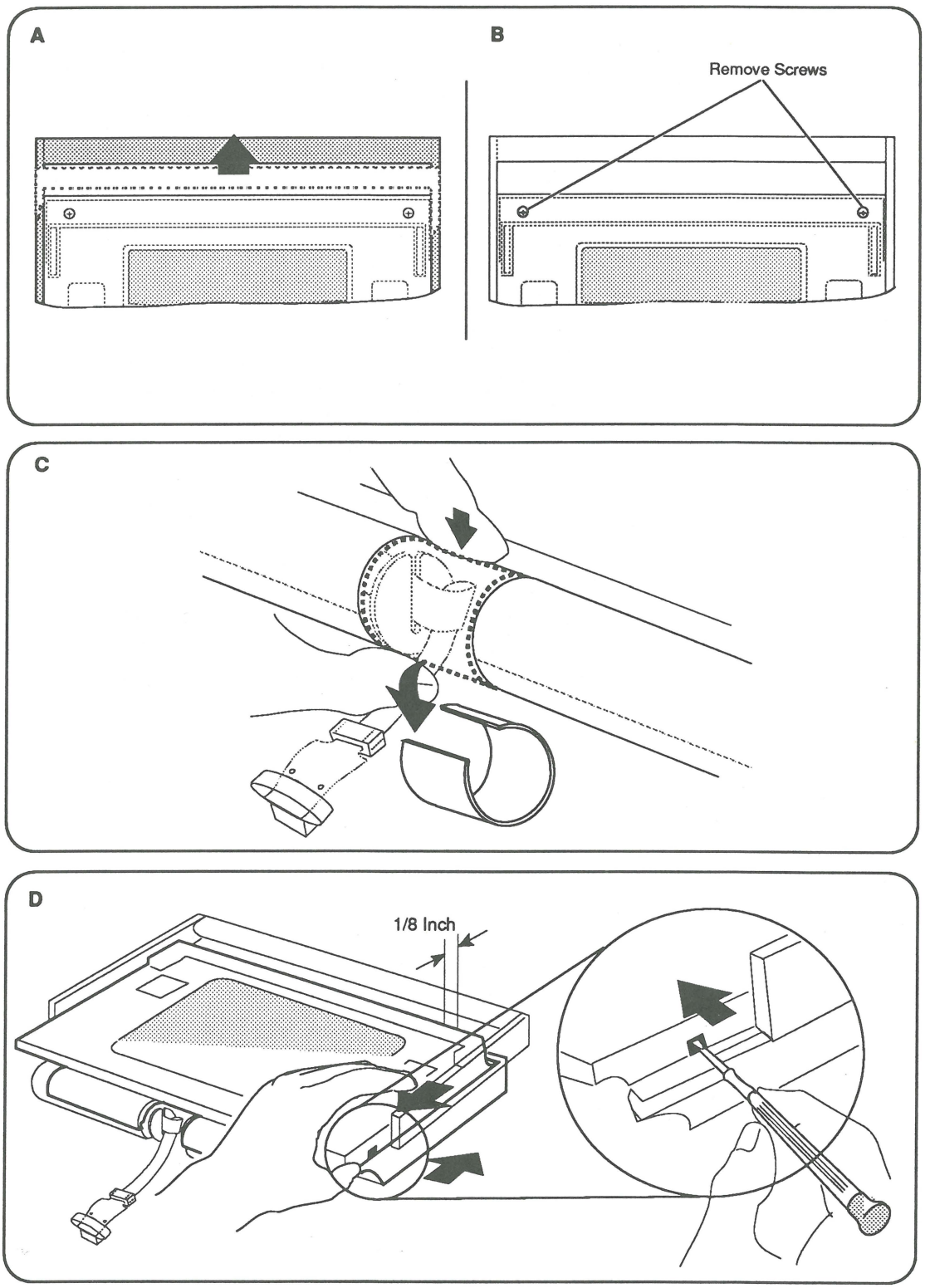


FIGURE 16

❑ LCD DISPLAY (BACKLIT)

6. Repeat step 5 for the left side. This time, however, hold the screwdriver with your left hand and move the display bezel and housing with your right.

7. **Figure 17-A**. Lift the display bezel and carrying handle off the display housing.

8. **Figure 17-B**. Disconnect the ccfl-lamp-to-inverter-PCA cable by pressing on the tab and pulling the two connector halves apart.

9. **Figure 17-C**. Disconnect the cable that connects the inverter PCA to the LCD display by **gently** sliding the latch away from the display and then sliding the cable from the connector.

   If you are removing only the inverter PCA, perform step 10 and stop. Otherwise, skip to step 11.

10. **Figure 17-D**. Use a jeweler's flat-blade screwdriver to **gently** pry the inverter PCA loose from the display housing. A little force is required since the PCA is held in place with double-sided tape.

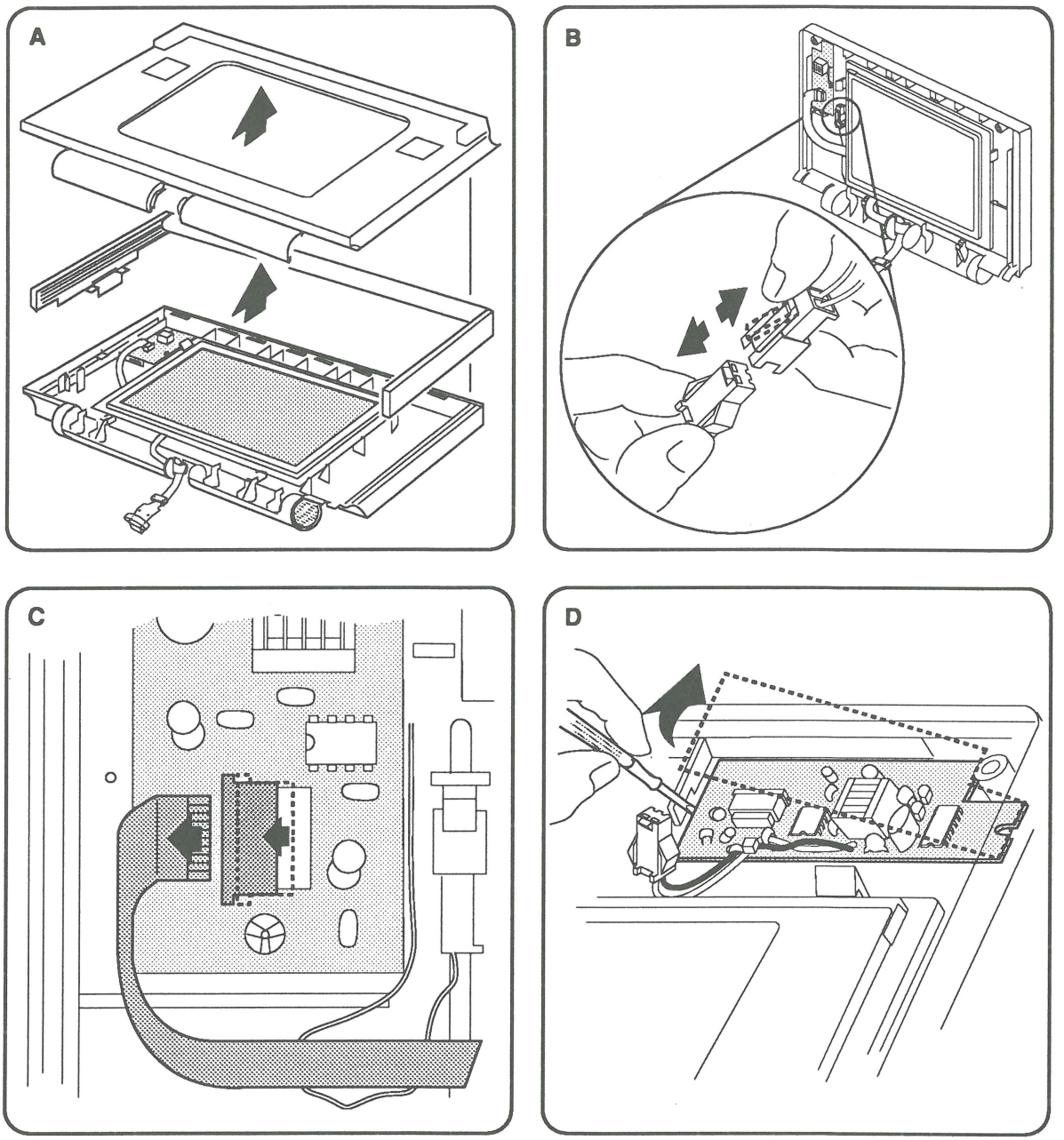


FIGURE 17

❑ LCD DISPLAY (BACKLIT)

11. **Figure 18-A**. Simultaneously pull the two plastic clips at the upper-left and upper-right sides of the display away from the display with your thumbs. Lift the display with your index fingers.

12. **Figure 18-B**. Slide the display up and out of the housing.

13. **Figure 18-C**. Disconnect the display cable by sliding the latch of the connector away from the connector and then sliding the cable from the connector.

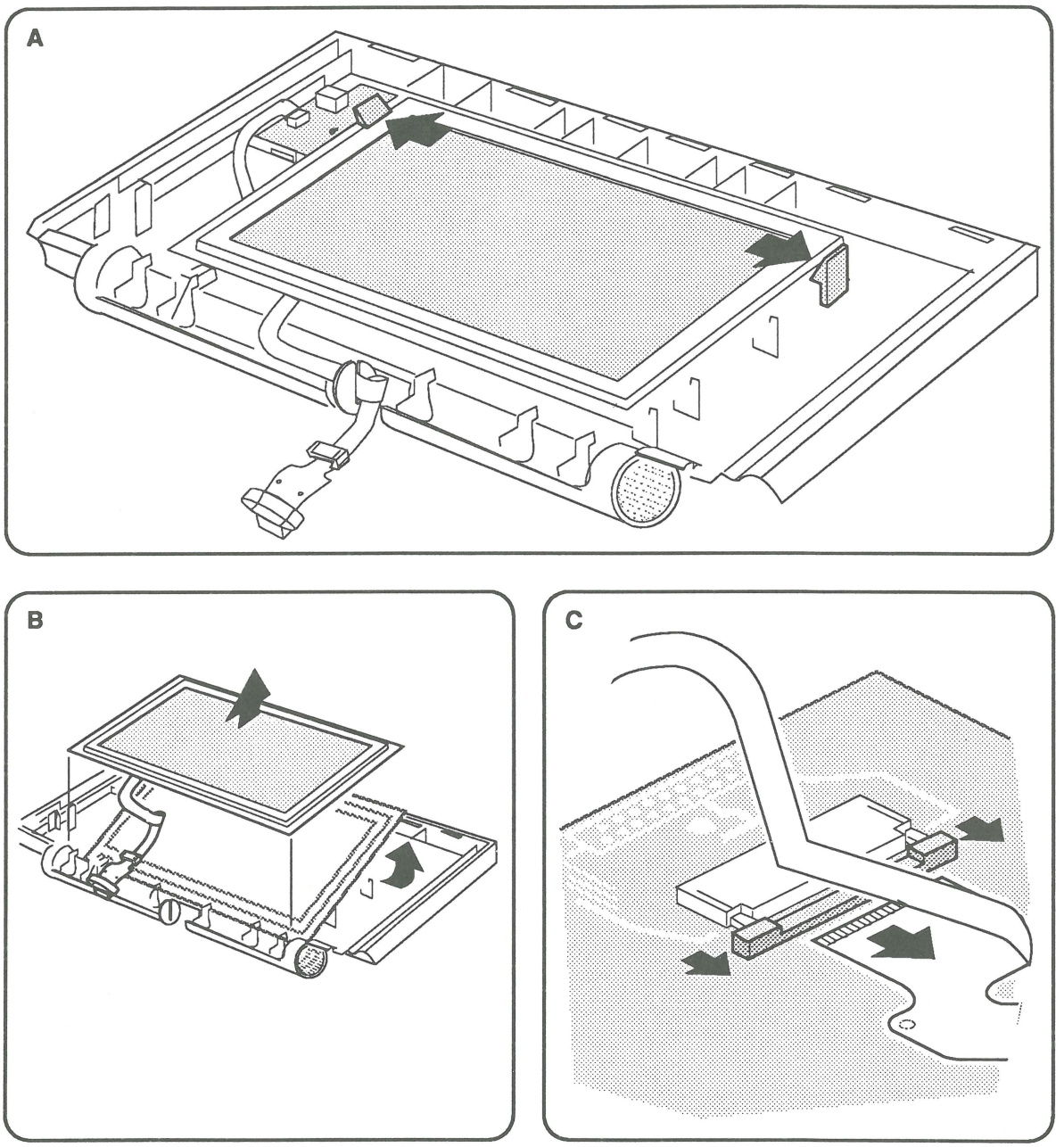


FIGURE 18

❑ LCD DISPLAY (BACKLIT)

Replace

1. **Figure 19-A**. Connect the display cable to the display by **gently** sliding the cable into the connector, printed side up. Make sure the cable is fully seated and straight in the connector. Slide the plastic latch toward the connector to secure the cable in place.

2. **Figure 19-B1**. Place the bottom edge of the display into the two plastic clips at the bottom of the display housing.

   Note: **Figure 19-B2**. Make sure the display cable is placed as shown. The cable must lie flat under the display, and the cable must be carefully placed in the channel.

3. **Figure 19-C**. Press down on the corners of the display with your thumbs until it snaps in place.

4. **Figure 19-D1**. Connect the ccfl-lamp-to-inverter-PCA cable.

5. **Figure 19-D2**. Connect the cable from the inverter PCA to the LCD display by **gently** sliding the cable into the connector. Make sure the cable is fully seated and straight in the connector. Slide the plastic latch toward the connector to secure the cable in place. Make sure the cable is bent upward at 90 degrees to the connector as shown in the illustration.

6. **Figure 19-E**. If you are replacing the inverter PCA, peel the paper from the tape on the back of the PCA and place the inverter in position. Press down gently to to make sure the adhesive sticks to the display housing.

7. Peel the protective plastic sheet from the display.

8. **Figures 19-F**. Place the carrying handle in position in the display housing. The plastic clips should be in the channel at the edge of the housing.

9. **Figure 19-F**. Place the display bezel on the housing as shown in the illustration. You'll need to hold the carrying handle in position.

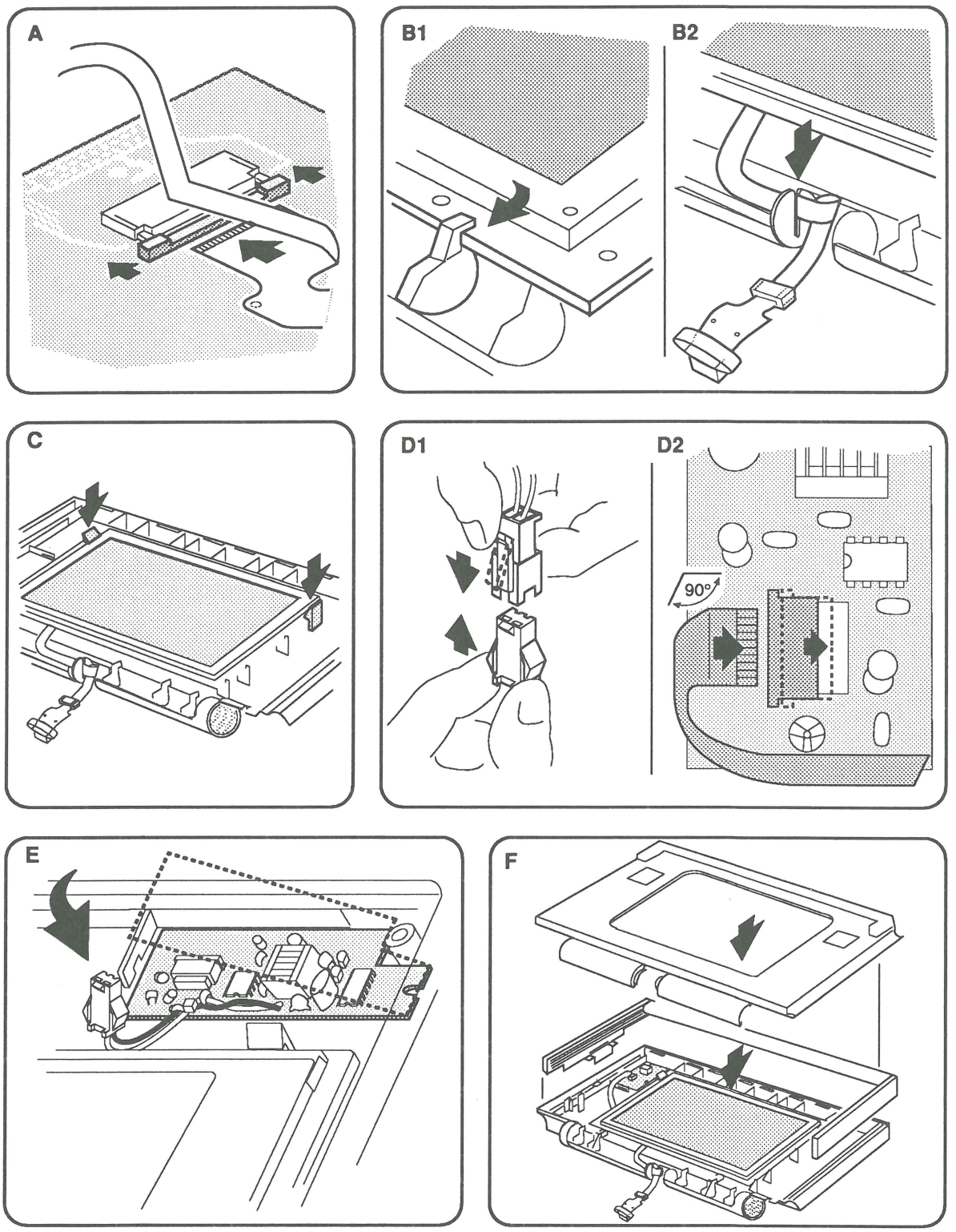


FIGURE 19

❑ LCD DISPLAY (BACKLIT)

10. **Figure 20-A**. Slide the bezel evenly toward the top of the housing as shown in the illustration.

11. **Figure 20-B**. Replace the two Phillips screws at the upper-right and upper-left corners of the display bezel.

12. **Figure 20-C**. Snap the center pivot cover back on the display pivot as shown in the illustration.

13. Replace the display assembly, keyboard cover, main battery, and rear cover.

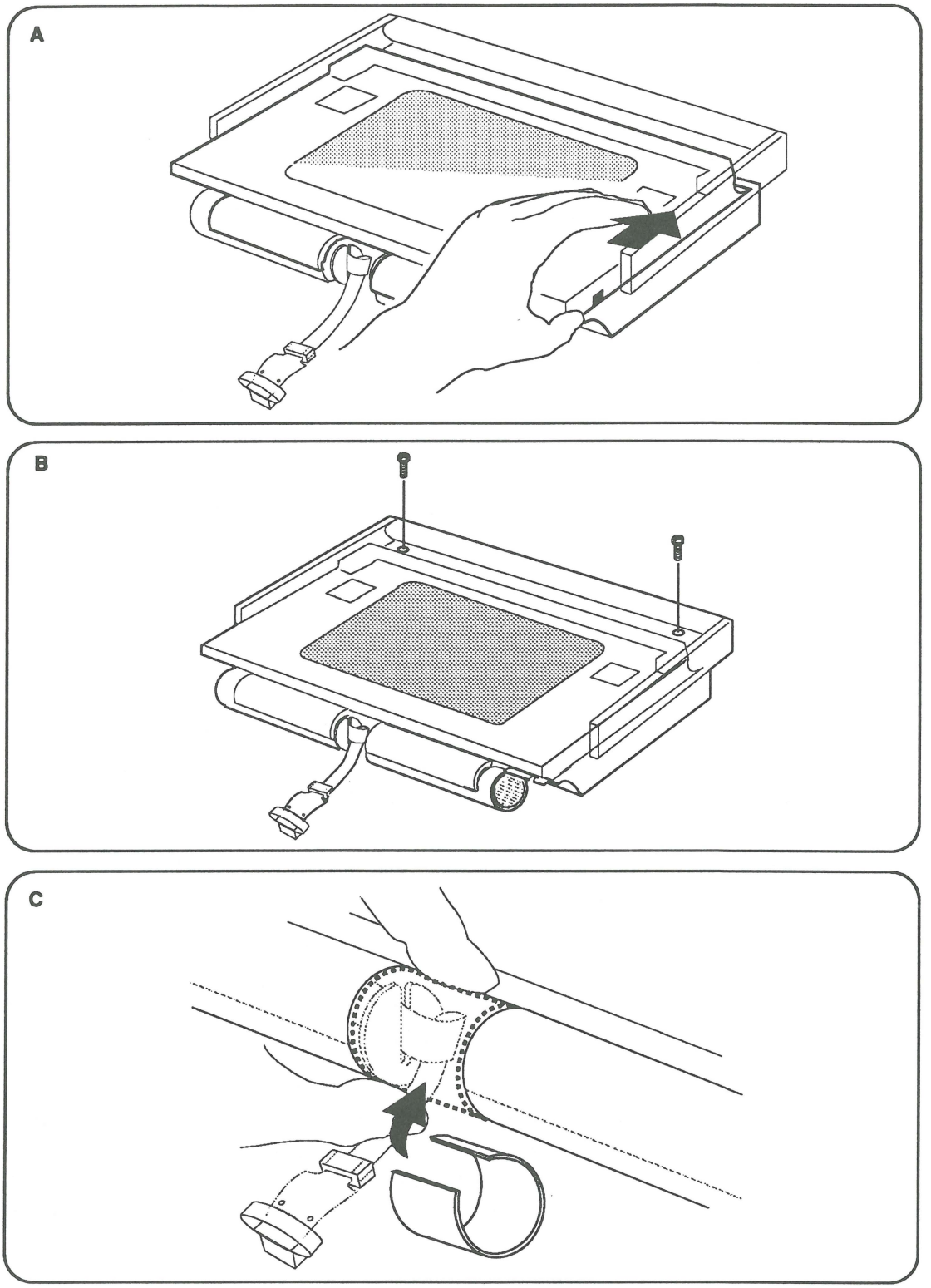


FIGURE 20

❑ LOGIC BOARD

Remove

1. Remove the rear cover, main battery, keyboard cover, display assembly, keyboard, and trackball or numeric keypad.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover or any modules. Failure to replace the battery cover can damage the computer.*

2. Remove any option cards installed.

3. **Figure 21-A**. Using the illustration as a guide, disconnect the following cables from the logic board:

   a) Input device cables, J13 (left side) and J20 (right side)

   b) Battery cable, J17

   c) SCSI hard disk drive cable (if present), J18

   d) Lower floppy disk drive cable, J14

   e) Upper floppy disk drive cable (if present), J15

   f) Speaker cable, J16

CAUTION: *While performing steps 4 and 5, be careful not to lift the subframe too far. Doing so will put excess strain on the subframe and logic board and could cause damage.*

4. **Figure 21-B1**. Locate the left subframe latch. Using the flat-blade screwdriver, pull the clip away from the subframe. When the clip is released, lift the left side of the subframe.

5. **Figure 21-B2**. While holding the left side of the subframe up—far enough to keep it from being held by the plastic clip—press on the clip at the right front of the subframe. Press the clip in far enough to release it. You can now lift the subframe a little farther.

6. **Figure 21-B3**. Use the flat-blade screwdriver to release the plastic clip at the right side of the subframe.

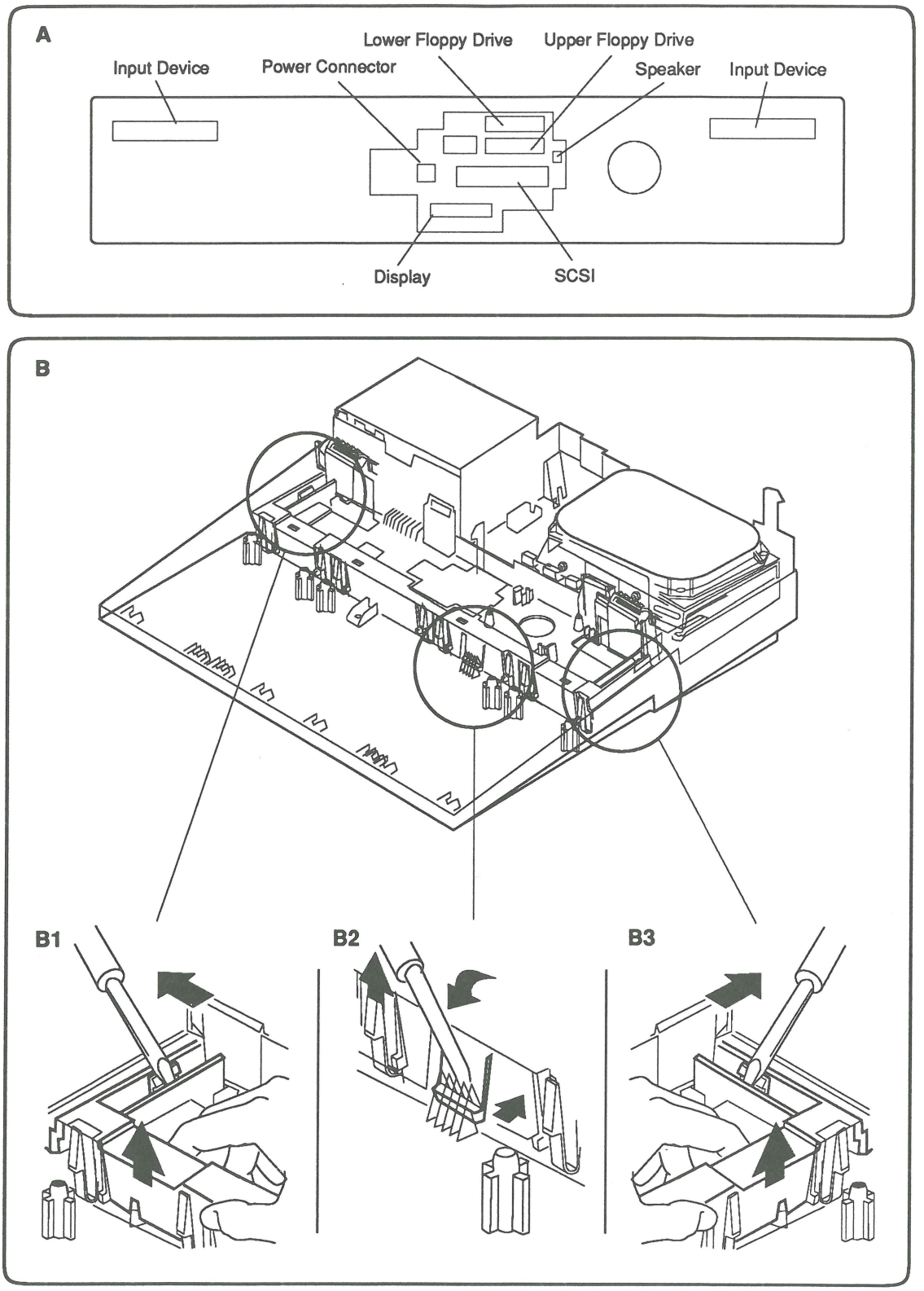

A
Lower Floppy Drive
Upper Floppy Drive
Input Device
Power Connector
Speaker
Input Device
Display
SCSI
B
B1
B2
B3

FIGURE 21

❑ LOGIC BOARD

7. **Figure 22-A**. Lift up the front of the subframe and pull it toward you to remove it from the bottom case.

8. Place the subframe assembly upside-down on your grounded workstation pad.

9. **Figure 22-B**. Release each of the plastic clips securing the logic board to the subframe. As you release each clip, gently lift the logic board and proceed to the next clip. Release the clips in the order shown in the illustration.

10. Remove the logic board from the subframe.

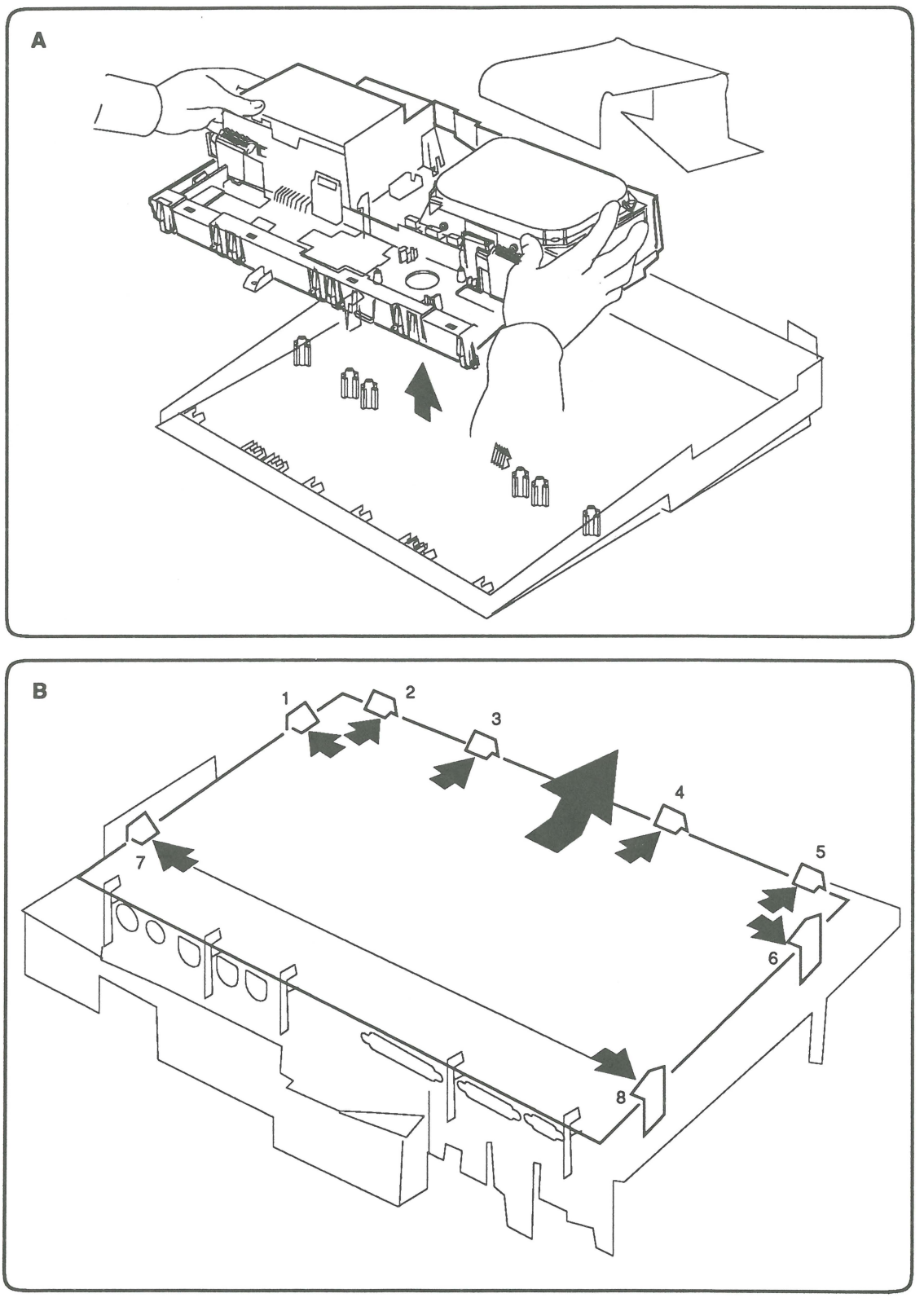


FIGURE 22

❑ LOGIC BOARD

Replace

1. **Figure 23-A**. Holding the logic board at an angle, place the rear edge of the logic board into the plastic clips at the back of the subframe.

2. **Figure 23-A**. Lower the front of the logic board into the subframe and gently but firmly press the board into each plastic clip in the order shown in the illustration.

3. **Figure 23-B**. Place the subframe in position in the bottom case.

4. **Figure 23-C**. Press down on the subframe as shown in the illustration until the three plastic clips snap in place.

5. **Figure 23-D**. Using the illustration as a guide, connect the following cables to the logic board:

   a) Input device cables, J13 (left side) and J20 (right side)

   b) Battery cable, J17

   c) SCSI hard disk drive cable (if present), J18

   d) Lower floppy disk drive cable, J14

   e) Upper floppy disk drive cable (if present), J15

   f) Speaker cable, J16

6. Replace any option cards removed.

7. Replace the display assembly, keyboard, trackball/numeric keypad, keyboard cover, main battery, and rear cover.

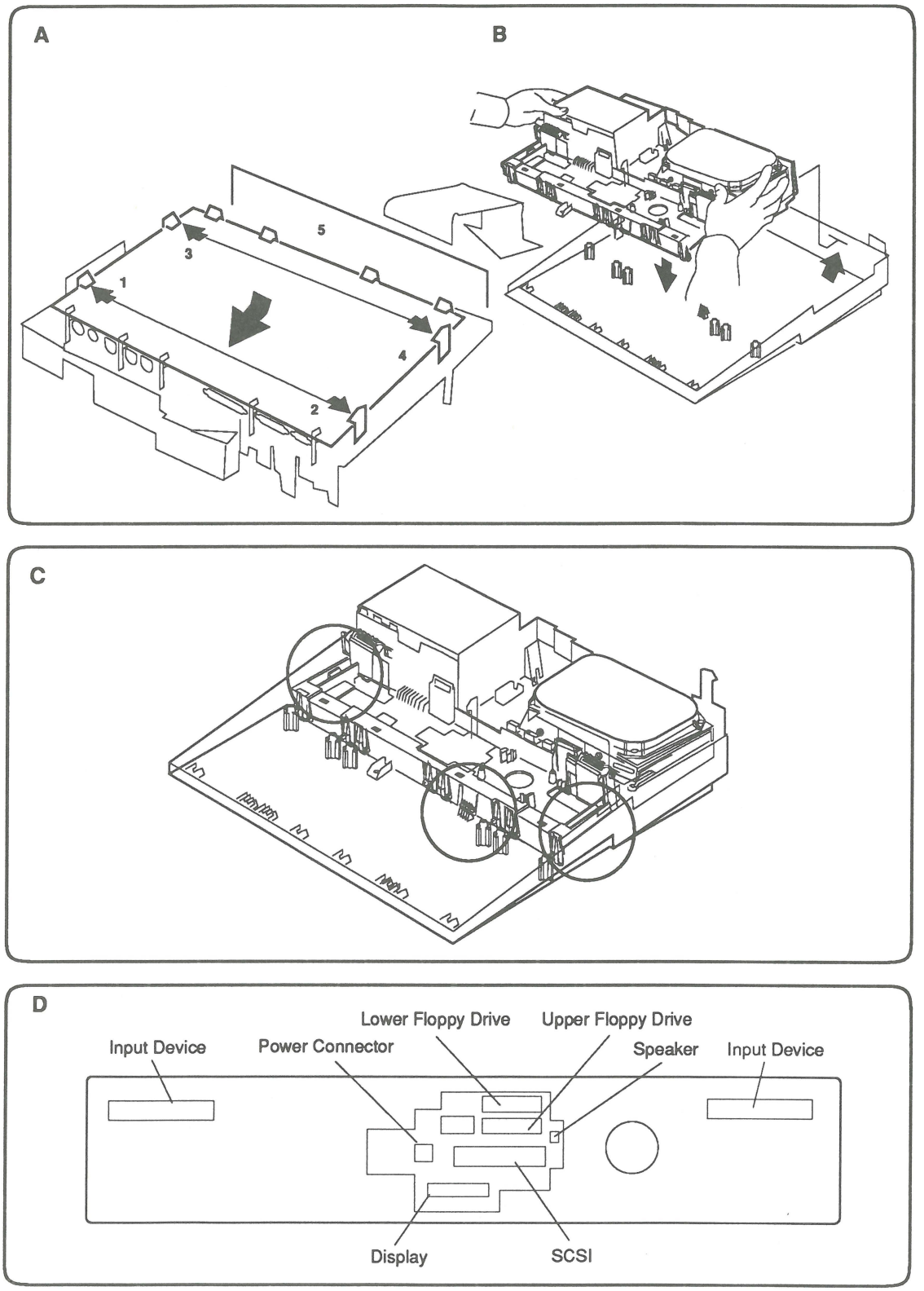

A
B
1
2
3
4
5
C
D
Lower Floppy Drive
Upper Floppy Drive
Input Device
Power Connector
Speaker
Input Device
Display
SCSI

FIGURE 23

Apple Technical Procedures

Macintosh Portable

Section 3 – Diagnostics

❑ CONTENTS

❑ INTRODUCTION

This revision of the Diagnostics section of the *Macintosh Portable Technical Procedures* incorporates version 2.0 of *MacTest Portable* and accommodates Macintosh Portables with the new backlit display and pseudostatic RAM chips.

IMPORTANT: *Do not run* MacTest Portable *under MultiFinder. Doing so could cause the diagnostic to crash or incorrectly identify the logic board as a failed module.*

If you run the diagnostic from a hard disk, be sure that MultiFinder is off. If it is on, select **Set Startup** under the Special menu and click **Finder**. Reopen the Special menu and select **Restart**.

IMPORTANT: *Run* MacTest Portable *version 2.0* ***only*** *with the system software included on the diagnostic disk. In other words, use system software version 6.0.4 with* MacTest Portable *version 2.0. Using system software version 6.0.5 or higher with* MacTest Portable *2.0 will produce false failures.*

MacTest Portable tests the following modules:

- Logic board
- LCD display
- Lower, upper, and external floppy disk drives
- Speaker
- Expansion RAM card

MacTest Portable does not test hard disk drives. To test a hard disk, use *Hard Disk Test.* Procedures for using *Hard Disk Test* can be found in Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures.*

INTRODUCTION ❑

MacTest Portable functions as a pass/fail confidence test. Running the program requires a functioning LCD display, one floppy disk drive, a trackball or mouse, and much of the logic board circuitry. Therefore, Apple recommends that you use *MacTest Portable* to verify the operation of the Portable after a repair or to check a suspect system.

As *MacTest Portable* progresses, messages on the screen indicate the test being performed and the results. When *MacTest Portable* detects a failure, the test stops and the failed module is indicated. The Test Log appears on the screen and can be printed or saved to disk.

USING MACTEST PORTABLE ❑

Materials Required

MacTest Portable diagnostic disk (backup)
Peripheral-8 serial interface cable
Blank 800K floppy disk (required for floppy drive tests)
Blank 1.4 MB floppy disk (required for floppy drive tests)

Note: Before you begin, use the Finder to **make a backup copy** of *MacTest Portable*. It is possible to damage or erase the disk during testing.

IMPORTANT: *Do* ***not*** *use a SCSI loopback board with MacTest Portable.*

❑ USING MACTEST PORTABLE

MacTest Setup

1. **Figure 1.** Plug in the power adapter, if available, and connect it to the Portable.
2. **Figure 1.** Connect the serial interface cable between the modem and printer ports.
3. Insert the diagnostic disk into an internal floppy disk drive and press any key except <Caps Lock> to bring the computer out of system sleep.
4. When the desktop appears, double-click on the MacTest Portable disk icon to open the disk.
5. Double-click on the MacTest Portable application icon.
6. Click the desired boxes in the Test Selections section of the main screen.

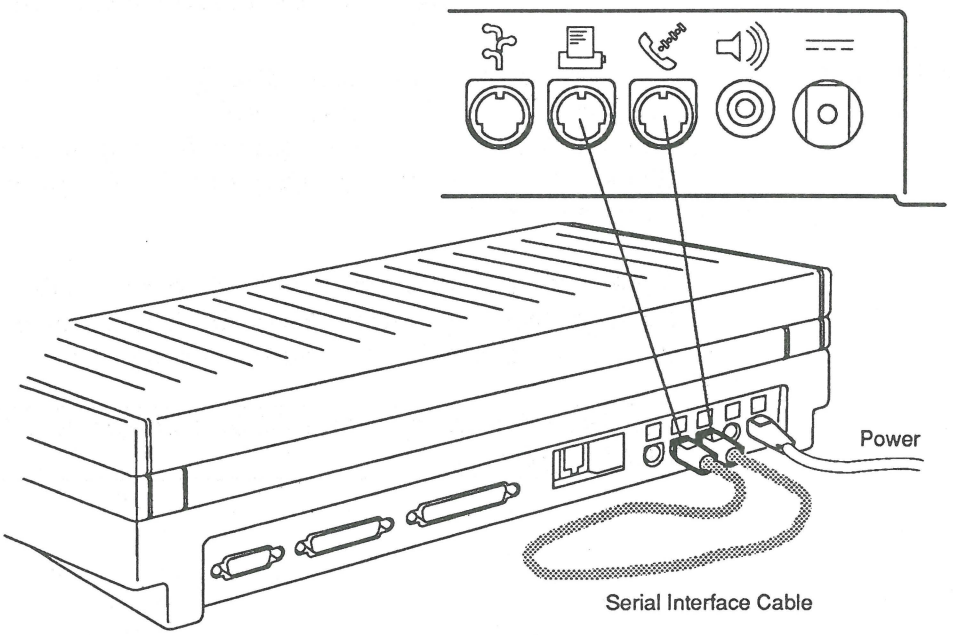


FIGURE 1

Test Selections

Figure 2. Test Selections allows you to select the tests you wish to run. To select a test, click the box next to the name of the test to be run. An **X** appears in the box. To deselect the test, click the box again and the **X** disappears. When you have selected the tests to be run, press <Return> or click **Start Tests**. The tests are described below.

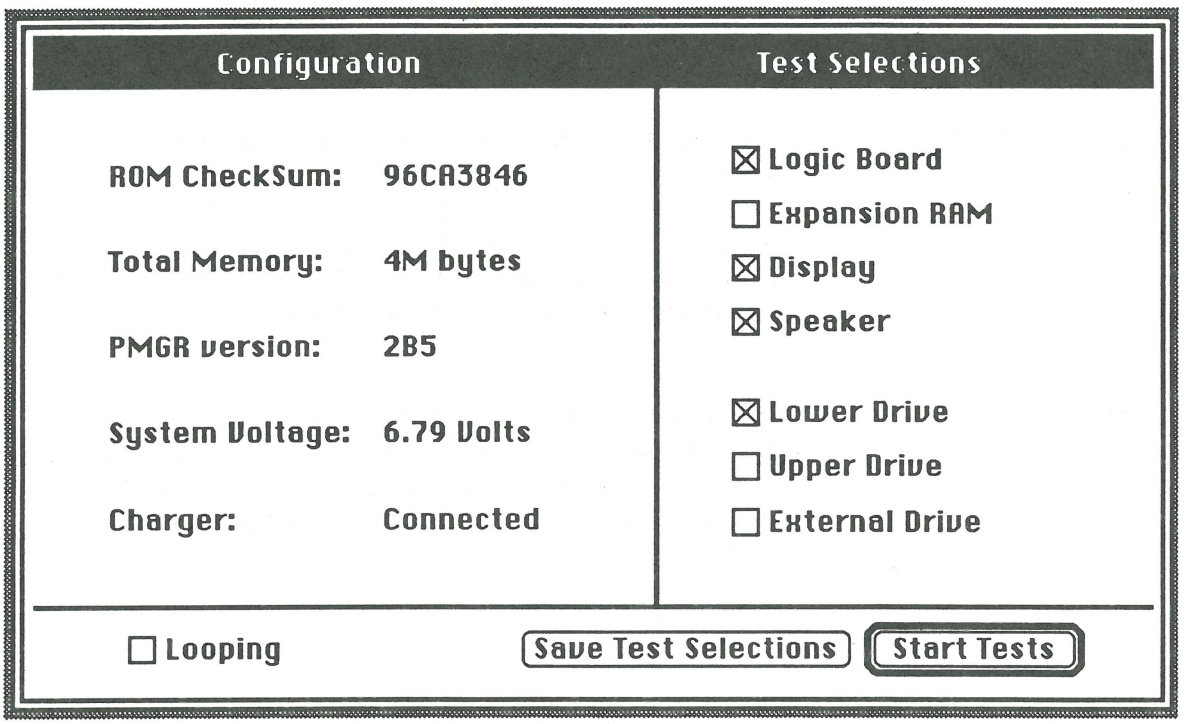


FIGURE 2

Logic Board

The Logic Board test performs a check of the following logic board circuitry:

- System ROM
- Video RAM
- System RAM (includes memory sizing and address and data line testing)
- Versatile Interface Adapter (VIA)
- Power Manager (PMGR)
- Serial Communications Controller (SCC)
- SCSI controller
- SWIM floppy disk controller
- Apple Desktop Bus interface

Note: An external loopback test is part of the SCC test. To perform this test, you must install a serial interface cable between the modem and printer ports. If you run the logic board test without installing a serial interface cable, you will have the option to skip the external loopback test. (You will **not** have the skip option if you select **Looping** on the *MacTest Portable* main screen.) Skipping the external loopback test will not fully test the serial ports and is not recommended.

Expansion RAM

The Expansion RAM test checks the optional 1 MB or 3 MB Expansion RAM card if one is installed.

Note: If you select the Expansion RAM test when no Expansion RAM card is installed, the diagnostic will report an Expansion RAM card failure.

Display

The Display test provides the following series of patterns, which are useful in checking for LCD display problems. In the explanations that follow, *nonbacklit* means incapable of backlighting—**not** a backlit display with the backlight off.

- **Crosshair** – Use the crosshair pattern to spot pixel alignment problems.
- **Diagonal Lines** – Use the diagonal lines to spot ghosting and pixel alignment problems.
- **Black** – Use the black screens to spot ghosting.

  For backlit Portables, you will see one screen; for nonbacklit Portables, the two following screens alternate:

  – Half-contrast

  – Full-contrast
- **White** – Use the white pattern to look for pixels that are stuck on.
- **Alternating** – Use this series of four screens to spot ghosting problems.

Speaker

The Speaker test checks the Apple Sound Chip and sounds a series of eight tones at an increasing volume, followed by a C-scale to check the speaker.

Lower Drive and Upper Drive

The Lower Drive and Upper Drive tests verify the operation of the lower and upper floppy disk drives. *MacTest Portable* tests the drives in GCR and low- and high-density MFM recording modes. The test requires blank 800K and 1.4 MB floppy disks. The disks do not need to be formatted.

External Drive

The External Drive verifies the operation of an external Macintosh 800K, Apple 3.5 Drive, or Apple FDHD/SuperDrive™ floppy disk drive. The Apple SuperDrive is tested in GCR and low- and high-density MFM recording modes. The Macintosh 800K and Apple 3.5 drives are tested in GCR and low-density (800K) only. The test requires blank 800K disks (for 800K drives) and 1.4 MB disks (for FDHD/SuperDrives). The disks do not need to be formatted.

Looping

Looping provides a continuous running of all selected tests. To stop tests from running, click **Stop** or press <Command>–. (period).

Notes about looping:

- *MacTest Portable* will run the power manager test (part of the logic board tests) on the first loop only. Subsequent loops will not test the power manager.
- Because the display test requires pressing the mouse button to change test patterns, looping will not work for the display test.
- If you loop on a disk drive test, you may select no other tests—except another floppy drive test.
- When looping on a disk drive test, you must choose 800K or 1.4 MB.

  Note: Because you must choose only one type of disk, looping on disk drive tests does not completely test the drive.

❑ USING MACTEST PORTABLE

Save Test Selections

Use this button at the bottom of the main screen when you wish to save your Test Selections. When you quit and restart *MacTest Portable*, the preselected tests will reappear. **Save Test Selections** in the menu bar is always grayed.

Configuration

The *MacTest Portable* main screen displays a variety of information that can aid in troubleshooting.

- ROM CheckSum – Indicates the version of system ROM installed.
- Total Memory – Displays the total amount of system RAM installed. A minimum of 1 MB is installed on the Portable. The optional 1 MB **static** Expansion RAM Card and 1 MB and 3 MB **pseudostatic** Expansion RAM Cards provide a total of 2 MB of RAM for static RAM logic boards or 4 MB for pseudostatic logic boards.
- PMGR Version – Displays the version of power manager microprocessor installed.
- System Voltage – Displays the voltage available to the Portable. If the power adapter is not connected, the value displayed is equal to the main battery voltage. If the power adapter is connected, the reading is influenced by the higher voltage coming from the power adapter and is not a true battery reading.
- Charger – Indicates whether the power adapter is plugged in and connected to the computer.

As the Tests Are Running

While the program is running, the following happens:

IMPORTANT: *Insert the correct floppy disk—low-density or high. If you insert the wrong disk,* MacTest Portable *will falsely indicate that the disk drive is malfunctioning.*

- The Status line at the bottom of the window specifies the tests performed and the results.
- If the serial cable is missing or improperly installed, testing will begin, but the test will stop and ask whether you want to skip the external loopback test. If you skip the external loopback test, the modem and printer port transceivers will not be tested. You should not skip this test.
- You can stop testing by clicking **Stop** or **Pause**:
  - Choose **Stop** to end testing and display the Test Log. Click **OK** to return to the Test Selections/ Configurations window. Choose **Start** when you wish to begin the testing sequence again.
  - Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption. The program may ask you to reinsert the program disk so it can continue.

  You may need to click **Stop** or **Pause** several times before the program acknowledges the mouse click.
- Replace any module that the diagnostic indicates has failed. Removal and replacement procedures are in Section 2, Take-Apart.
- If all tests pass, the diagnostic displays the Test Log. The message **All selected test(s) passed** appears on the screen.
- If looping is selected, a counter displays the number of complete loops.

❑ USING MACTEST PORTABLE

MacTest Portable Menus

You can choose the following *MacTest Portable* features by using the menu bar.

Apple Menu

The Apple (🍎) menu contains the following selection:

- **About MacTest Portable** – Displays a dialog box containing the diagnostic name, version number, and release date.

File Menu

The File menu displays the following items:

- **Stop** (<Command>- .) – Stops the diagnostic tests. Grayed when tests are not running.
- **Quit** (<Command>- Q) – Terminates the program and returns to the Finder (desktop).

Illustrations Menu

The Illustrations menu displays the following items:

- **Setup** – Always grayed.
- **Expansion RAM** – Shows the location of the Expansion RAM card.
- **Main Battery** – Shows the location of the main battery.
- **Backup Battery** – Shows the location of the backup battery.

Configuration

AppleCAT/MacTest Portable displays a variety of information that can aid in troubleshooting.

- ROM Checksum – Used to determine the version of system ROM installed.
- Total Memory – Displays the total amount of system RAM installed. A minimum of 1 MB is installed on the Portable. The optional 1 MB Expansion RAM Card provides a total of 2 MB of RAM.
- PMGR Version – Displays the version of power manager microprocessor installed.
- System Voltage – Displays the voltage available to the Portable. If the power adapter is not connected the value displayed is equal to the main battery voltage. If the power adapter is connected, the reading is influenced by the higher voltage coming from the power adapter and is not a true battery reading.
- Charger – Indicates whether the power adapter is plugged in and connected to the computer.

As the Tests Are Running

While the program is running,

- The *Status Line* at the bottom of the window keeps you informed of the tests being performed and the test results.
- If the logic board test is selected and the serial loopback plug (AppleCAT) or serial cable (MacTest) is missing or improperly installed, testing will begin, but the test will stop and ask whether you want to skip the external loopback test. If you skip the external loopback test, the modem and printer port transceivers will not be tested. You should not skip this test.
- It is important to insert the requested low- or high-density disk. If the wrong disk is inserted, MacTest/AppleCAT will indicate that the disk drive is malfunctioning and should be replaced when it may not be malfunctioning.

- You can stop testing by clicking **Stop** or **Pause** between tests:

  - Choose **Stop** to end testing and display the Test Log. Click **OK** to return to the Test Selections/Configurations window. Choose **Start** when you wish to begin the testing sequence again.

  - Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption. The program may ask you to re-insert the program disk so it can continue.

  You may need click **Stop** or **Pause** several times before the program acknowledges the mouse click.

- If the test station fails to establish communication with the UUT (AppleCAT), you don't need to quit and restart the program. Selecting any of the items in the Illustrations menu will cause the program to try to establish communication again.

- Replace any module that the diagnostic indicates has failed. Removal and replacement procedures can be found in Section 2, Take-Apart.

- If all tests pass, the diagnostic displays the Test Log. The message **All selected test(s) passed** appears on the screen.

- If looping is selected, a counter displays the number of complete loops.

AppleCAT/MacTest Portable Menus and Keyboard Equivalents

AppleCAT/MacTest Portable has a number of features accessible using the menu bar and keyboard equivalents.

Apple Menu

The Apple (🍎) menu contains the following selection:

- **About Diagnostic** – Displays a dialog box containing the diagnostic name, version number, and release date.

File Menu

The File menu displays the following items:

- **Stop** (<Command>-.) – Stops the diagnostic tests.
- **Quit** – Terminates the program and returns to the Finder (desktop).

Illustrations Menu

The Illustrations menu displays the following items:

- **Setup** – Displays instructions on setting up *AppleCAT/MacTest Portable.*
- **Expansion RAM** – Shows the location of the Expansion RAM card.
- **Main Battery** – Shows the location of the main battery.
- **Backup Battery** – Shows the location of the backup battery.

Known Problems

Selecting certain combinations of tests and looping options in *AppleCAT/MacTest Portable* version 1.0.1 can yield inaccurate results.

When using *AppleCAT/MacTest Portable* version 1.0.1:

- Do not select the Logic Board Test and Expansion RAM Test together. The Power Manager Test may fail if this combination is selected.

- You may receive an untrue ADB Test failure if you select looping with the Logic Board Test. If you receive an ADB Test failure while looping is selected, verify the results by retesting with looping deselected. If the ADB Test fails again, replace the logic board. If any other test fails during looping, no retesting is necessary; proceed as necessary to repair the unit.

- Do not run the diagnostic under MultiFinder or select looping while in remote mode. Doing so could cause the diagnostic to crash or incorrectly identify the logic board as a failed module.

Apple Technical Procedures

Macintosh Portable

Section 4 – Troubleshooting

❑ CONTENTS

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

❑ INTRODUCTION

Before You Start

Read the sections titled "Things to Remember," "Module Exchange Information," and "Startup Chords," before you begin troubleshooting. You need the information provided in these sections to troubleshoot the Macintosh Portable effectively.

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.

If the symptoms displayed by the Macintosh Portable are not listed in the symptom charts or if the system is not displaying a clearly defined problem, use the troubleshooting flowcharts.

How to Use the Troubleshooting Flowcharts

There are two numbered troubleshooting flowcharts for the Macintosh Portable computer. These flowcharts are useful in troubleshooting startup-related problems.

The troubleshooting flowcharts are designed to verify operation of the Macintosh Portable in its minimum configuration. Therefore, before using the troubleshooting flowcharts, remove any options installed and disconnect any external peripherals.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. If the problem remains, reinstall the original module before you go on to the next action.

Things to Remember

- Be sure to follow all electrostatic discharge precautions when working on the Macintosh Portable. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for additional information.

- To prevent possible damage to the computer, be sure to read the "Functional Overview" in Section 1, Basics prior to troubleshooting.

- Before you begin troubleshooting, remove all option cards and disconnect any external devices (printers, SCSI device, ADB devices, and disk drives).

  After the Macintosh Portable is fully operational, each option card or peripheral should be installed and tested. Install one device and test the system before adding any others. Repeat the install-and-test process until all devices have been installed and tested.

- When running the *Hard Disk Test* diagnostic to test the hard disk, be sure to operate the computer from the power adapter and do not select looping.

- To ensure that customers receive the same system configuration that they bring in, record the following information before beginning:

  - Type and serial number of any option cards
  - Whether a SCSI hard disk or second FDHD floppy drive is installed
  - Position and types of input devices installed

- The Macintosh Portable requires system software 6.0.5 or later (nonbacklit display) or 6.0.7 or later (backlit display). Earlier versions of system software do not support the Portable and may cause damage to the computer, reduce battery life, or cause a loss of data. If a system is installed with an earlier version, install the correct version and reverify the failure **before** beginning troubleshooting. Many times problems that appear hardware related are actually caused by software. System software installation procedures are included in Section 1, Basics.

❑ MODULE EXCHANGE INFORMATION

SCSI Hard Disk Drive

Do not attempt to remove the bracket attached to the SCSI hard disk drive. The four mounting screws are tightened at the factory to exact specifications. Tampering with these screws can cause loss of data or damage to the hard disk drive.

FDHD SuperDrive Floppy Disk Drive

The FDHD SuperDrive floppy disk drive module is shipped without the 20-pin flat cable. Be sure to keep the disk drive cable with the customer's system.

Keyboard and Numeric Keypad

Two versions of keyboards and numeric keypads are available. The original Macintosh Portable keyboards and numeric keypads have a steel mounting plate. The new keyboards and numeric keypads have an aluminum mounting plate. The mounting plates can be distinguished by the colors of their finishes on the underside of the keyboard. The steel mounting plate has a black finish and the aluminum has a silver finish. The keyswitches are also different and have a different feel. When replacing a keyboard or numeric keypad, the replacement module should have the same mounting plate.

LCD Display

Two versions of LCD displays are available—backlit and nonbacklit. The two displays require different cables and neither the displays nor the cables are interchangeable.

The service module of the LCD display ships without the display cable. Be sure to keep the display cable with the customer's system.

❑ MODULE EXCHANGE INFORMATION

Logic Board

Two versions of logic boards are available. Although these boards are functionally equivalent, they do have several differences that prevent them from being interchangeable. Original logic boards use static RAM and do not support the backlit LCD display without the use of the ROM adapter. Newer logic boards use pseudostatic RAM and do support the backlit LCD display. Also, if a customer has a system with a static RAM expansion card, this card will not work if installed in a pseudostatic RAM logic board. Pseudostatic-RAM logic boards can be distinguished from static logic boards in two ways: by counting the number of RAM chips and checking whether the connector has a notch. The board with pseudostatic RAM has eight chips and has a notch in the connector; the board with static RAM has thirty-two chips and no notch.

❑ STARTUP CHORDS

Introduction

When you press any key except <Caps Lock>, the Macintosh Portable comes out of sleep mode or begins a startup sequence, depending on whether the system was shut down or in system sleep. If the system was shut down, the computer begins a startup sequence. The system sounds a startup chord (tone), the screen goes to grey, ROM self-tests execute, and the system looks for a startup device from which to load the Macintosh operating system. If any part of the self-test fails, a sequence of chords sounds and the startup sequence aborts.

Startup Sequence

During a normal startup sequence, a medium-pitched chord sounds (the familiar tone that every Macintosh emits when switched on); then a disk icon with a flashing question mark indicates that the system is looking for a valid startup disk. If a hard disk is attached, switched on (if an external drive), and contains a valid system folder and boot tracks, then the system boots without displaying the question mark.

Error Chords

If a startup chord and additional chords sound, a failure has been detected during the system self-test. Three sequences (startup chord, error chord, and test monitor chord) play if an error is encountered during startup.

If error chords sound during system startup, replace the logic board.

Power Problems	Solutions
• *The screen is blank; computer not responding*	1. If the computer is new, verify that the plastic sheet has been removed from between the battery and the contacts. 2. Reset the power manager. 3. Connect the power adapter and try the computer again in three or four minutes. 4. Try a known-good, charged main battery. If the computer now works, replace the main battery. 5. Verify that the keyboard cable is securely connected at both ends. 6. Replace the keyboard. 7. Replace the keyboard cable. 8. Replace the logic board.
• *After removing the main battery, some Control Panel settings are different*	1. Was the battery cover replaced when the main battery was removed? If it was, power to the computer was interrupted and this is normal. Restore the contents of the Control Panel. 2. Replace the backup battery.
• *Power adapter is plugged in and connected, but the battery DA does not indicate the charger is connected*	1. Verify the charger is connected properly. 2. Try a different main battery. If the battery now charges, replace the main battery. 3. Replace the power adapter. 4. Replace the logic board.
• *A low-power warning is displayed soon after starting to use the computer*	1. The battery needs recharging. Attach the power adapter. 2. Make sure peripherals display the low-power icon. 3. Extensive use of floppy or hard disk, modem, sound, backlight, or other power-consuming device. Reduce use of these devices or connect the power adapter.
• *The battery needs recharging after the computer is unused for four or more days*	– If system software 6.0.4 is used and AppleTalk is active, using the **Shut Down** command allows the serial communications controller (SCC) to draw excess current. To prevent the SCC from drawing excess current, select **Sleep** from the Special menu or deactivate AppleTalk using the Chooser prior to selecting **Shut Down**. Apple recommends correcting this problem by upgrading to system software 6.0.5.

❑ SYMPTOM CHART

Video Problems	Solutions
• *Some pixels never come on (blacken); no pattern*	– A maximum number of five permanently OFF pixels (voids) is considered acceptable. If the display contains six or more voids, replace the LCD display.
• *Some pixels are always black; no pattern*	– If any pixel remains on constantly, replace the LCD display.
• *A row of pixels never blackens*	1. Replace the LCD display. 2. Replace the display cable. 3. Replace the logic board.
• *A row of pixels is always black (black streaks)*	1. Replace the LCD display. 2. Replace the display cable. 3. Replace the logic board.
• *No display, but the computer appears to be operating correctly*	1. Verify that the display cable is securely connected. 2. Replace the LCD display. 3. Replace the display cable. 4. Replace the logic board.
• *The display looks blurred*	1. Adjust the angle of the display. 2. Adjust the screen contrast setting using the Control Panel.
• *The display looks dark (nonbacklit display)*	1. Not enough light is available. Locate the computer closer to direct light or move the light source closer to the computer. 2. Adjust the screen contrast setting using the Control Panel. 3. Replace the LCD display. 4. Replace the logic board.
• *The display is too light (nonbacklit display)*	1. Adjust the angle of the display. 2. Adjust the screen contrast setting using the Control Panel. 3. Replace the LCD display.

...Continued on next page

Video Problems (continued)	Solutions
• *Backlight level cannot be changed*	– Verify that version 1.3 of the Portable CDEV is being used. Earlier versions do not support the backlight feature. (To check the version of the CDEV, locate and select the file named Portable in the system folder and select **Get Info** from the File menu.)
• *Backlight doesn't operate*	1. Verify that version 1.3 of the Portable CDEV is being used. Earlier versions do not support the backlight feature. (To check the version of the CDEV, locate and select the file named Portable in the system folder and select **Get Info** from the File menu.) 2. Check inverter PCA connections. 3. Replace inverter PCA. (Refer to take-apart for the backlit version of the LCD display.) 4. Replace LCD display. 5. Replace logic board.

❑ SYMPTOM CHART

Floppy Disk Drive Problems	Solutions
• *Audio and video present, but internal drive does not operate*	1. Try a different floppy disk. 2. Replace the floppy disk drive. 3. Replace the floppy disk drive cable. 4. Replace the logic board.
• *The disk ejects while booting; display shows Mac icon with blinking "X"*	1. Try a known-good system disk. 2. Replace the floppy disk drive. 3. Replace the floppy disk drive cable. 4. Replace the logic board.
• *Disk will not eject*	1. Shut down the computer, press and hold down the trackball or mouse button, and switch on the computer. 2. Eject the disk manually by pushing an opened paper clip into the hole located near the disk drive in the bottom case. 3. Replace the floppy disk drive. 4. Replace the floppy disk drive cable. 5. Replace the logic board.
• *Disk initialization fails*	1. Verify that Apple-certified media are being used. 2. Try a different disk. 3. Replace the floppy disk drive. 4. Replace the logic board.

SCSI Hard Disk Drive Problems	Solutions
• *Internal hard disk will not operate*	1. Verify that any external SCSI devices connected to the Portable are turned on. 2. Verify that the SCSI hard drive cable is securely connected. 3. Use HD SC Setup to see whether the drive is visible. If it is, reinitialize the drive. 4. Replace the hard disk drive. 5. Replace the logic board.

Peripheral Problems	Solutions
• *After connecting an external SCSI device, the computer no longer boots*	1. Turn on the external SCSI device before starting up the computer. 2. Verify that proper cable termination is provided. 3. Verify that no two SCSI devices have the same device address. 4. Replace the logic board.
• *Cursor does not move when using the trackball*	1. Reset the power manager. 2. Check the cable connections between the trackball and the logic board. 3. Replace the trackball cable. 4. Replace the trackball. 5. Replace the logic board.
• *Cursor intermittently does not move or moves erratically*	1. Clean the trackball ball and internal rollers. 2. Replace the trackball.
• *Cursor does not move when using the mouse*	1. Check mouse connection to the ADB port. 2. Reset the power manager. 3. Clean the mouse ball and inside the mouse. (Procedures for cleaning the mouse are located in Cross Family Peripherals, Volume 1, *You Oughta Know.*) 4. Replace the mouse. 5. Replace the logic board.
• *Cursor moves, but clicking the button has no effect*	1. If it's the trackball button that isn't working, replace the trackball cable. If it's the mouse button, replace the mouse. 2. Replace the trackball. 3. Replace the logic board.

...Continued on next page

❑ SYMPTOM CHART

Peripheral Problems (continued)	Solutions
• *No response to any key on the keyboard*	1. If the screen is blank and you are trying to bring the computer out of system sleep, try resetting the power manager. 2. Check the keyboard connection to the logic board. 3. Replace the keyboard. 4. Replace the logic board.
• *Known-good ImageWriter, ImageWriter II, or LQ will not print*	1. Make sure system software 6.0.5 or later is installed. 2. Make sure that the Chooser is set correctly. 3. Replace the printer cable. 4. Replace the logic board.
• *Known-good LaserWriter will not print*	1. Make sure system software 6.0.5 or later is installed. 2. Make sure that the Chooser is set correctly. 3. Try another printer. If that printer works, the computer is OK. Refer to the *Networks* tab in *Apple Service Technical Procedures* for further assistance. 4. Replace the logic board.
• *Device connected to the external modem port doesn't work*	1. Verify that **External Modem** is selected in the Portable CDEV. 2. If System 6.0.4 is installed, upgrade to system software 6.0.5 or later. 3. Replace the logic board.
• *Serial devices are unrecognized or garbage is transmitted and/or received*	– If System 6.0.4 is installed, be sure the Macintosh Portable INIT version 1.0 is present in the system folder. This problem can also be corrected by upgrading to system software 6.0.5 or later.

Peripheral Problems (continued)	Solutions
• *When using an external modem: after exiting a communication application and putting the computer to sleep three or four times, the computer freezes when the computer comes out of system sleep*	– If system 6.0.4 is installed, upgrade to system software 6.0.5 or later.

Internal Modem Problems	Solutions
• *Internal modem options do not appear in the Portable CDEV when the modem is installed*	1. Try removing and reseating the card. 2. Replace the modem card. 3. Replace the logic board.
• *Modem does not respond properly to AT command set instructions*	1. Verify that the baud rate and data format settings of the communications application are compatible with the Portable Data Modem 2400/Int'l XP 2400 and the remote modem. 2. Replace the modem card.
• *Modem interferes with system sound*	1. Replace the modem card. 2. Replace the logic board.
• *Modem does not respond to incoming call*	1. If the system doesn't respond to an incoming call during sleep mode, verify that the When Phone Rings option in the Automatic Wake-up section of the Portable CDEV is selected. 2. Replace the modem card. 3. Replace the logic board.
• *Modem has no sound output*	– Replace the modem card.

❑ SYMPTOM CHART

Miscellaneous Problems	Solutions
• *Screen goes blank and computer shuts down every few minutes*	– The computer is going into system sleep to conserve battery power. If the computer is going into system sleep too often, adjust the sleep delays in the Control Panel or connect the power adapter.
• *Some applications seem to run slower after running for a few seconds*	– Computer is switching to system rest. If system rest is interfering with the operation of an application, refer to Section 1, Basics, "System Software" for instructions to disable system rest.
• *The hard disk is slow to respond, or the screen goes blank too often*	– The computer is powering down the hard disk or going into system sleep to conserve battery power. If the hard drive is shutting down or the system is going into system sleep too often, adjust the sleep delays in the Control Panel or connect the power adapter.
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is 1 or above. 2. Check the speaker connection to the logic board. 3. Replace the speaker. 4. Replace the logic board.
• *Screen suddenly goes blank*	– The computer has gone into system sleep to conserve battery power.

TROUBLESHOOTING FLOWCHARTS ❑

Introduction

Before beginning troubleshooting using the flowcharts, you should perform a quick inspection to eliminate any obvious problems. Perform a check of the following items:

- Verify that the main battery is installed and is charged. To check the battery voltage, refer to "Battery Verification" later in this section.
- Make sure the battery cover is installed.
- Remove the keyboard cover and verify that all the connectors to the logic board are securely attached.

❑ TROUBLESHOOTING FLOWCHARTS

Troubleshooting Flowchart 1

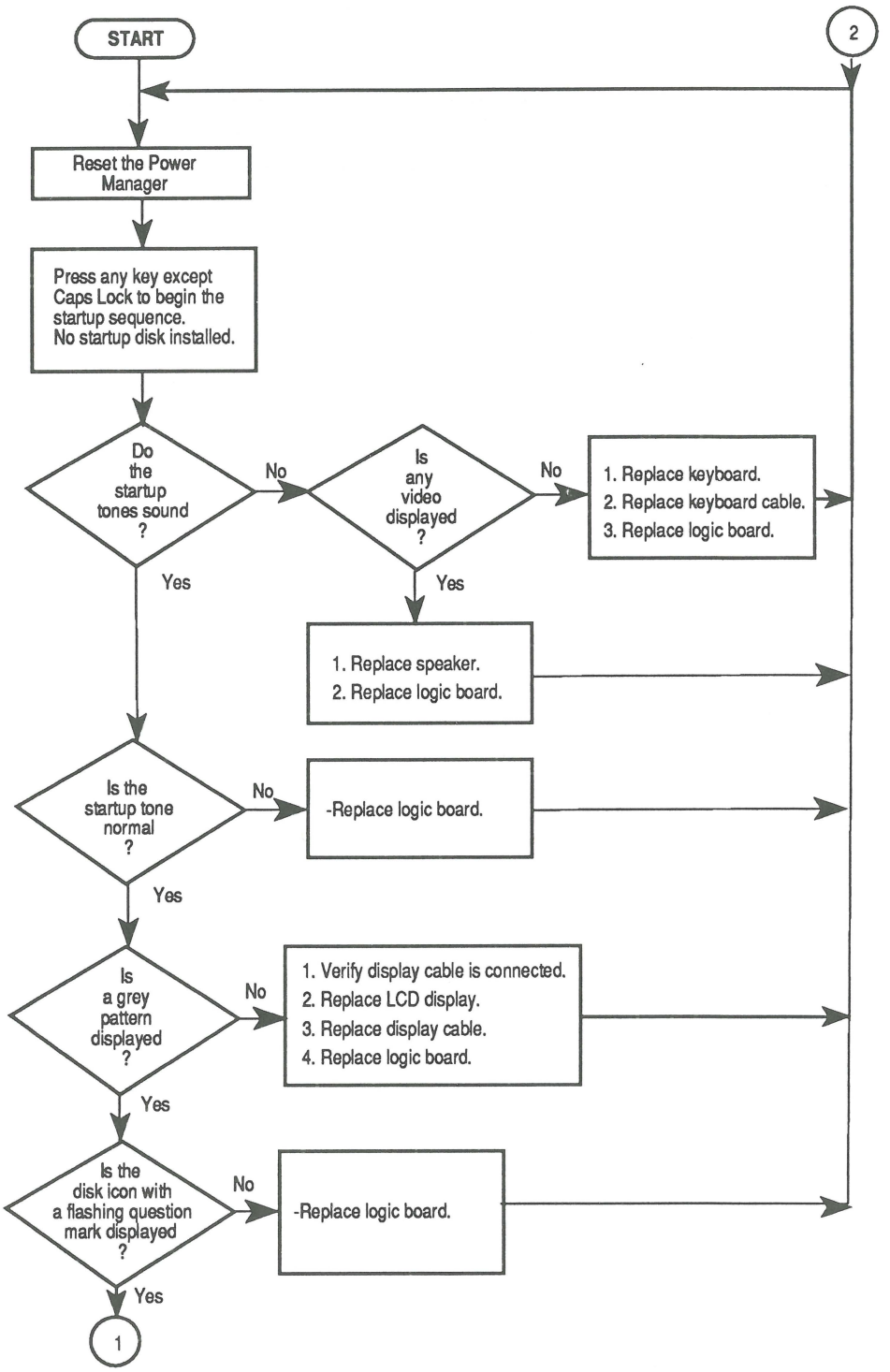


FIGURE 1

Troubleshooting Flowchart 2

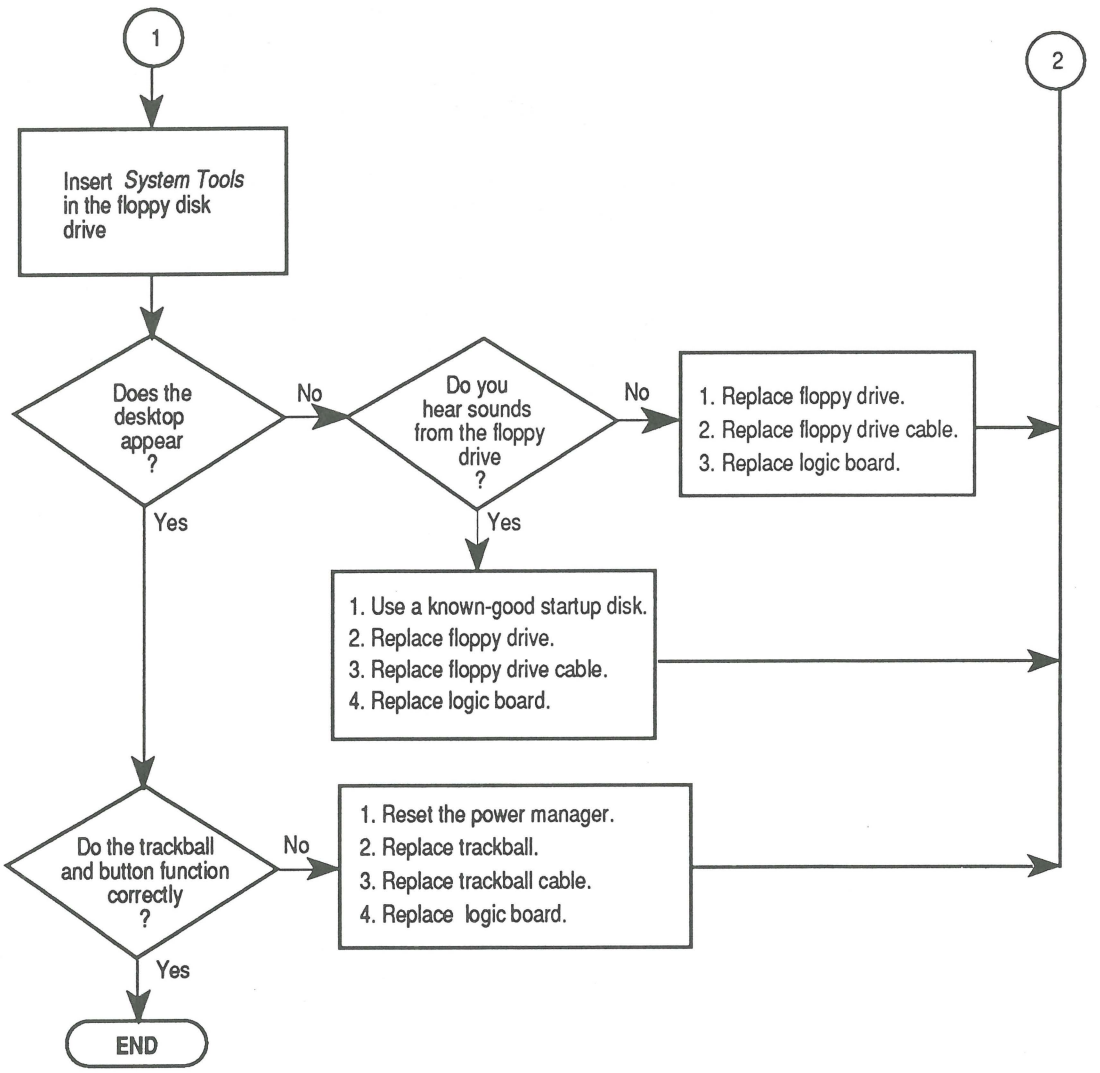


FIGURE 2

❑ BATTERY VERIFICATION

Materials Required

Digital voltmeter

Procedure

1. Disconnect the power adapter.
2. Remove the main battery.
3. Set the voltmeter range to measure 10 volts DC.
4. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery.
5. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the battery.
6. The reading for a good battery should be **above 5.7 volts**. If the battery falls below 5.7 volts, try recharging it. If the battery will not recharge, replace it.

Apple Technical Procedures

Macintosh Portable

Section 5 – Additional Procedures

❑ CONTENTS

Note: If a step is underlined, detailed instructions for that step can be found in Section 2, Take-Apart.

CAUTION: *Before beginning any take-apart procedure, be sure to read the "Power Information" subsection. This subsection contains important precautions you should use to prevent possible damage to the Macintosh Portable.*

❑ INTRODUCTION

Power Information

Prior to removing or replacing any modules within the Macintosh Portable, you must unplug the power adapter, remove the main battery, and replace the battery cover. By replacing the battery cover you prevent the computer from attempting to operate using the 9-volt battery. **Failure to replace the battery cover can cause damage to the computer.**

CAUTION: *If a RAM disk is present, be sure to save its contents before removing the main battery and replacing the battery cover. Otherwise, RAM disk contents will be lost.*

Electrostatic Discharge (ESD) Precautions

The Macintosh Portable makes extensive use of low-power CMOS devices. These devices are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you are unwrapping, installing, or replacing any modules, observe the appropriate ESD precautions. Complete information on ESD prevention and workstation setup can be found in *You Oughta Know.*

❑ SCSI HARD DISK INSTALLATION

The minimum configuration of the Macintosh Portable includes a single Apple FDHD floppy disk drive. This configuration can be upgraded to include a 40 MB, 3.5-inch low-power SCSI hard disk. These procedures cover the installation and check-out of the hard disk. Troubleshooting information is located in Section 4, Troubleshooting.

Materials Required

Jeweler's screwdriver
Grounded workstation pad
Grounding wriststrap
40 MB low-power SCSI hard drive
Macintosh Hard Disk Test (version 1.0 or later)
Macintosh System software (version 6.0.4 or later)
HyperCard version 1.2.3

Installation

1. Disconnect the power adapter.

2. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover. Failure to replace the battery cover can damage the computer.*

3. Remove any option cards installed.

4. **Figures 1-A and 1-B.** Release the floppy retainer from the subframe by pulling the two plastic tabs away from the retainer and then lifting the holder from the subframe.

5. **Figure 1-C.** Lower the hard drive into the subframe, align the four metal tabs, and press down until the plastic latches at the front and rear snap in place.

CAUTION: *Make sure the disk drive flat cable does not get caught under the metal disk drive bracket. Otherwise, the cable could be damaged.*

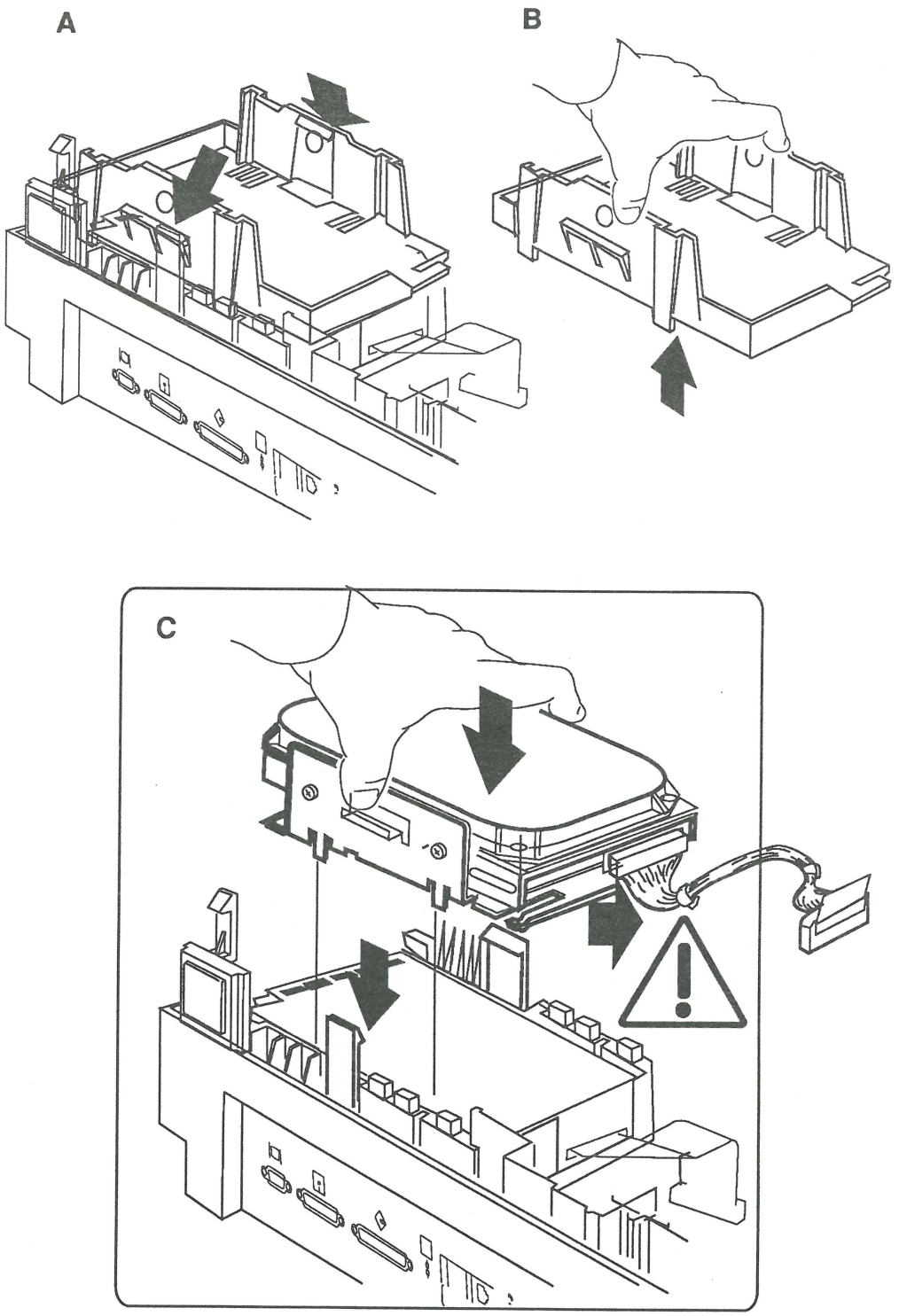


FIGURE 1

❑ SCSI HARD DISK INSTALLATION

6. **Figure 2-A**. Disconnect the display cable from logic board connector J19.

7. **Figure 2-B**. Slide the hard drive cable through the opening under the display assembly.

8. **Figure 2-C**. Connect the hard drive cable to logic board connector J18.

9. **Figure 2-D**. Connect the display cable to logic board connector J19.

10. Replace any option cards removed.

11. Replace the keyboard cover, main battery, and rear cover.

Check-out

After installing the hard drive, you should run *Macintosh Hard Disk Test* (version 1.0 or later) to verify that the drive is operating properly. If you are unfamiliar with running *Hard Disk Test*, procedures can found in the *SCSI Hard Disk Drives* section of *Apple Service Technical Procedures.*

CAUTION: *If you are using version 1.0 of the Macintosh Hard Disk Test, be sure to operate the computer with the power adapter connected. Do not select the "Loop on selected tests" option or damage to the LCD display could result.*

System Software and HyperCard

After installing and testing the hard disk, proceed to Section 1, Basics, "System Software" for procedures to install System software and HyperCard.

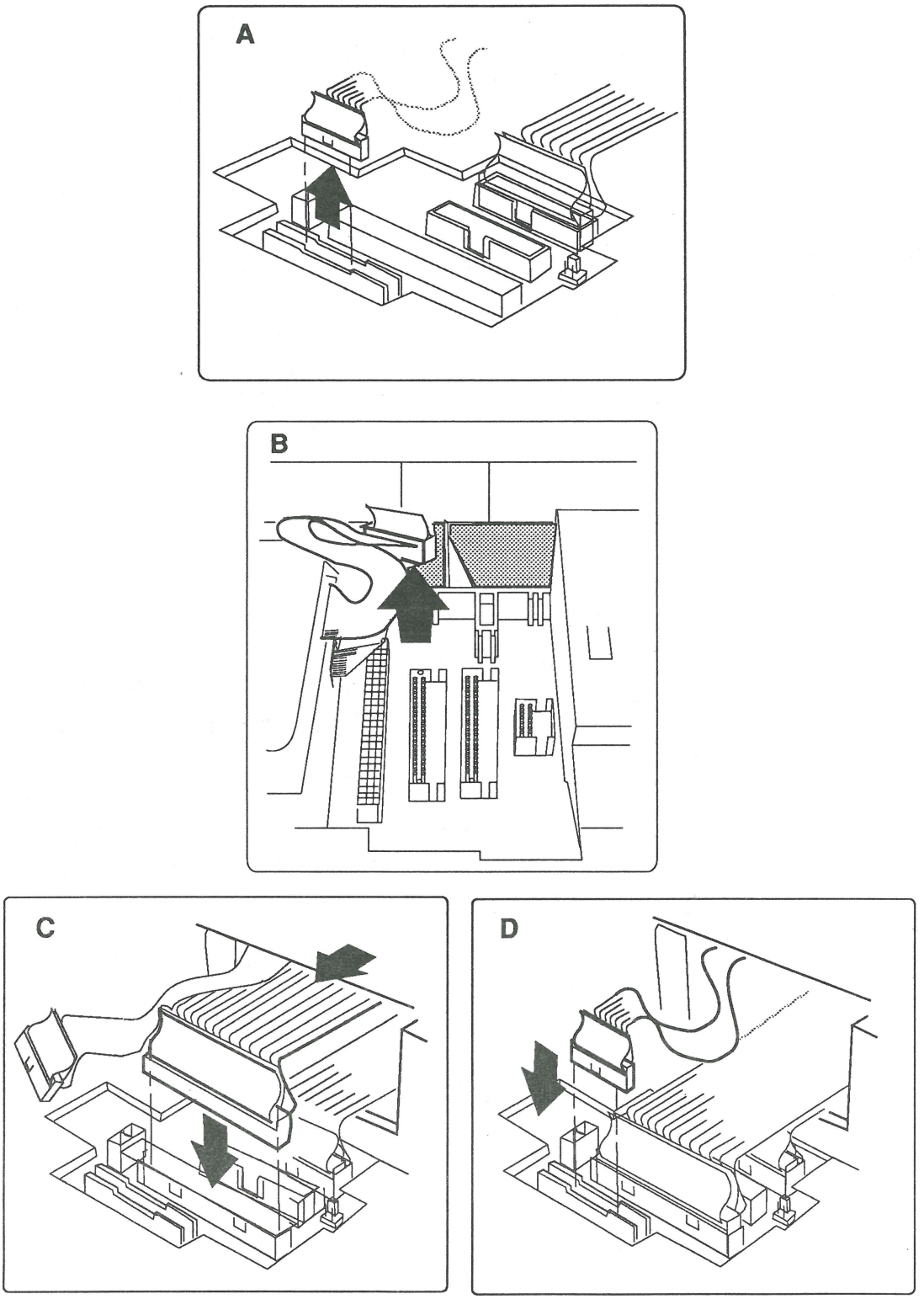


FIGURE 2

❑ UPPER FDHD FLOPPY DISK DRIVE INSTALLATION

The minimum configuration of the Macintosh Portable includes a single Apple FDHD floppy disk drive. This configuration can be upgraded to include a second internal FDHD disk drive. These procedures cover the installation and check-out of the FDHD drive. Troubleshooting information is located in Section 4, Troubleshooting.

Materials Required

Jeweler's screwdriver
Grounded workstation pad
Grounding wriststrap
Apple FDHD floppy disk drive option kit
Macintosh System Tools version 6.0.4 or later
Blank, unformatted, high-density floppy disk

Installation

1. Disconnect the power adapter.

2. Remove the rear cover, main battery, and keyboard cover.

CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover. Failure to replace the battery cover can damage the computer.*

3. Remove any option cards installed.

4. **Figures 3-A and 3-B.** Hold the rear cover with the underside facing up. Remove the standard bezel from the rear cover by releasing the three plastic snaps as shown. Release the snaps in the order indicated. Then pull the bezel away from the cover.

5. **Figure 3-C.** Install the new floppy bezel as shown.

6. **Figures 3-D and 3-E.** Release the floppy retainer from the subframe by pulling the two plastic tabs away from the retainer and then lifting the holder from the subframe.

7. **Figure 3-F.** Place the floppy drive mechanism into the floppy retainer.

UPPER FDHD FLOPPY DISK DRIVE INSTALLATION ❑

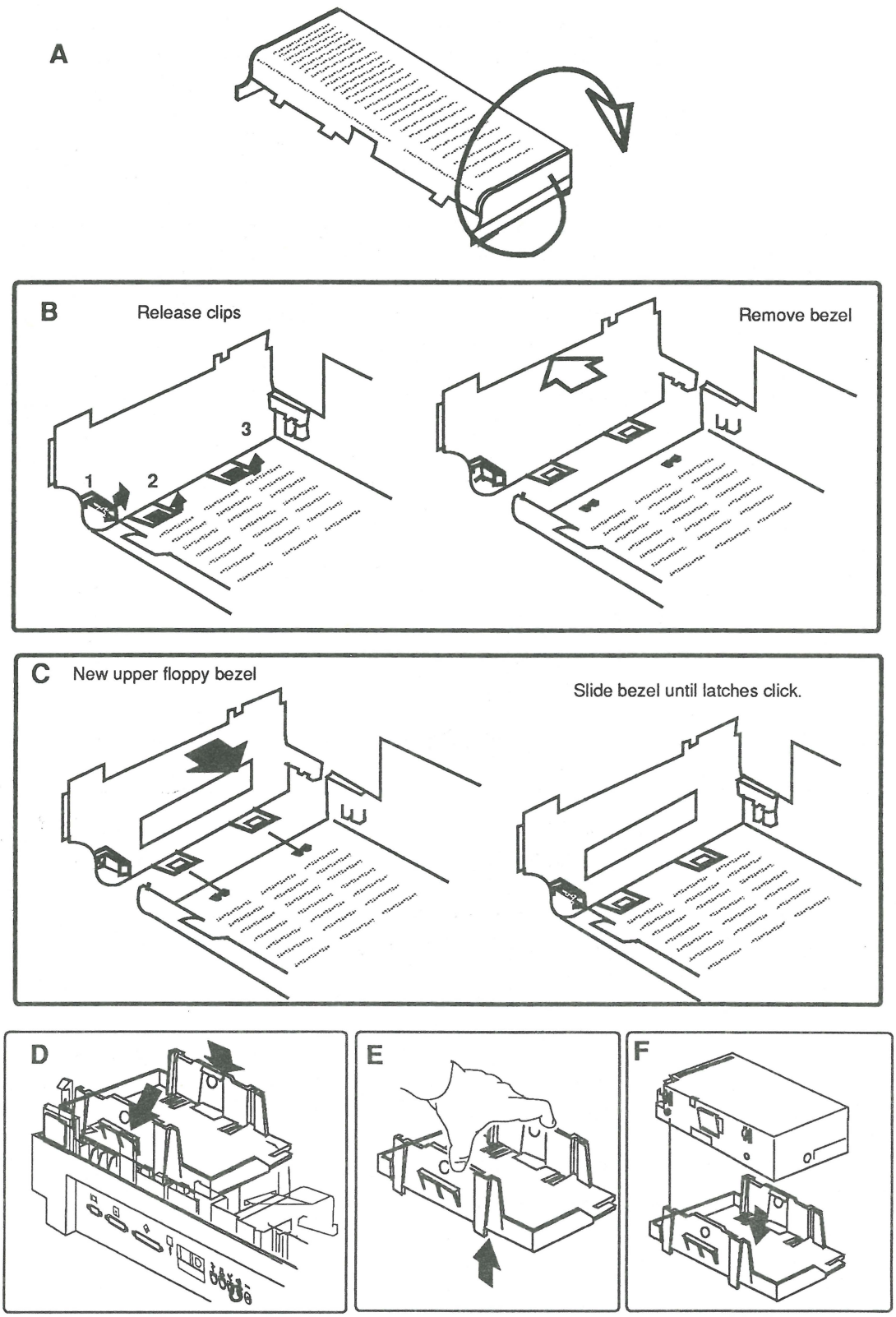


FIGURE 3

❑ UPPER FDHD FLOPPY DISK DRIVE INSTALLATION

8. **Figure 4-A**. Lower the disk drive into the subframe, align the four metal tabs, and press down until the plastic latches at the front and rear snap in place.

9. **Figure 4-B**. Disconnect the display cable from logic board connector J19.

10. **Figure 4-C**. Route the floppy drive cable under the display assembly as shown.

11. **Figure 4-D**. Connect the floppy drive cable to logic board connector J15.

12. **Figure 4-E**. Connect the display cable to logic board connector J19.

13. **Figure 4-F**. Connect the other end of the floppy drive cable to the upper disk drive.

14. Replace any option cards removed.

15. Replace the keyboard cover, main battery, and rear cover.

Check-out

1. Insert the *System Tools* disk in the lower floppy drive.

2. Turn on the computer by pressing any key except <Caps Lock>.

3. When the desktop appears, place the blank high-density disk in the upper drive.

   Follow the prompts and format the disk.

4. When the disk is formatted, click on the *System Tools* disk icon and drag it on top of the icon for the blank disk.

   If you have any problems formatting or copying the *System Tools* disk, refer to Section 4, Troubleshooting.

UPPER FDHD FLOPPY DISK DRIVE INSTALLATION ❑

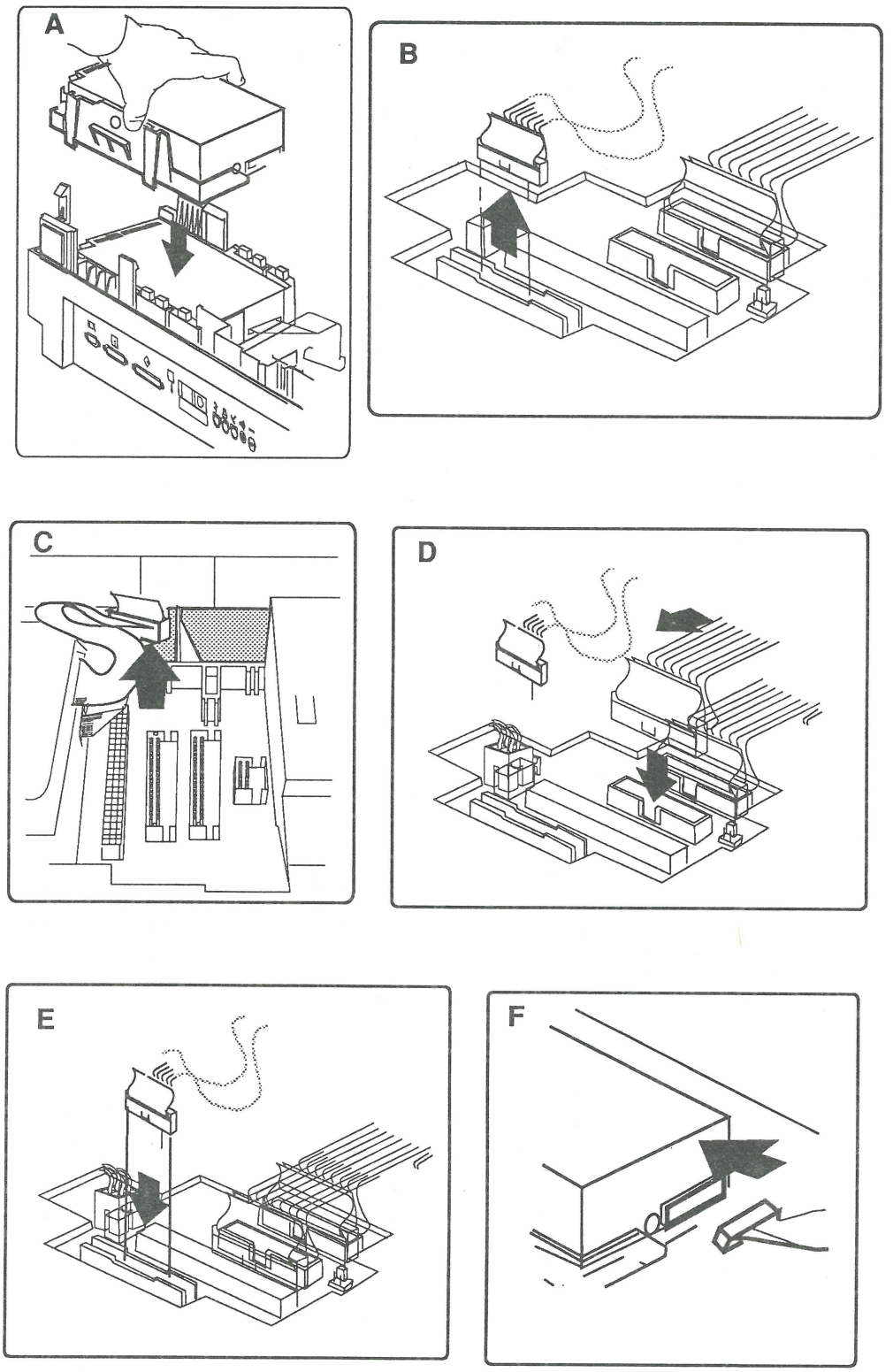


FIGURE 4

❑ MACINTOSH PORTABLE DATA MODEMS

Product Description

These procedures provide an overview, installation instructions, troubleshooting procedures, and specifications for the Macintosh Portable Data Modem 2400 and the Int'l XP 2400 modem.

The Portable Data Modem 2400 (US and Canada) and the Int'l XP 2400 (international) are optional internal 2400 bps modems for the Macintosh Portable computer. Features of the modems include:

- Auto dialing and auto/manual answering
- Automatic restoration of previous configuration after return from system sleep
- Dual-tone modulated-frequency (DTMF—Touch-Tone™) dialing and pulse dialing
- Support of a subset of the Hayes® AT command set
- Low-power design to conserve battery power
- Local and remote self-test
- Support of the Bell 103 (300 bps), Bell 212A (1200 bps), CCITT V.22A/B (1200 bps), and CCITT V.22bis (2400 bps) communication standards
- Supports optional error detection and correction using Microcom Network Protocols (MNP) levels 4 and 5 (Int'l XP 2400 only; error detection and correction is not available for the Portable Data Modem 2400)
- External data access arrangement (DAA) adapters to support various telephone standards around the world (for use with the Int'l XP 2400 only)

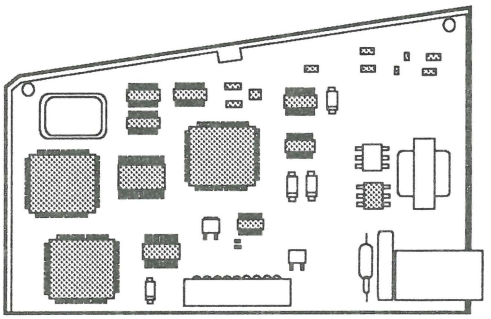
The Portable Data Modem 2400 is shown in **Figure 5-A**, the Int'l XP 2400 is shown in **Figure 5-B**, a DAA is shown in **Figure 5-C**, and the MNP option board is shown in **Figure 5-D**.

Theory of Operation

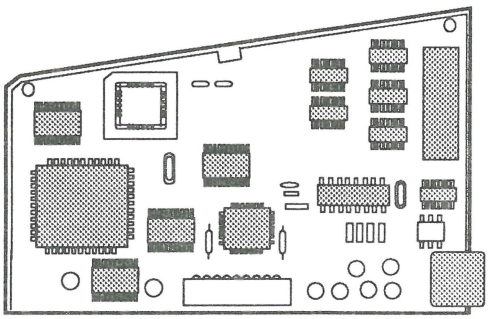
The modem is designed around three main components. (Refer to **Figure 5-E** while reading the Theory of Operation.)

- A N83C51FA single-chip microcontroller
- A TMS320C15 digital signal processor (DSP)
- A MSM6950B analog front end (AFE)

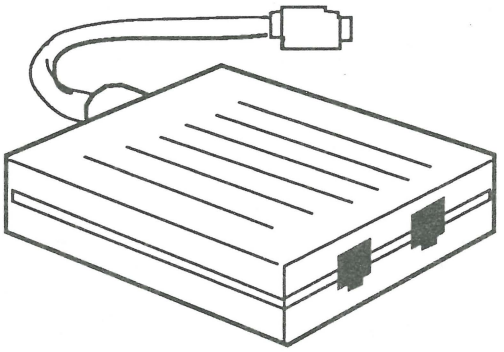
A Portable Data Modem 2400



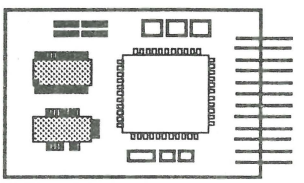
B Int'l XP 2400



C Data Access Arangement (DAA)



D MNP Option Board



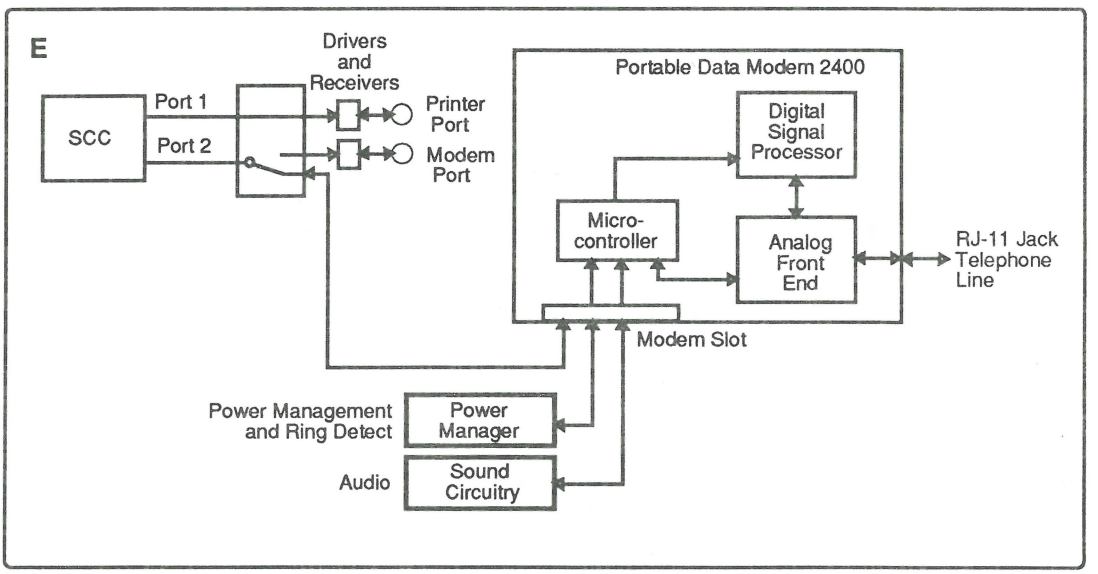


FIGURE 5

❑ MACINTOSH PORTABLE DATA MODEMS

The 83C51FA microcontroller provides overall control of the modem. It manages the serial interface and processes the AT commands sent from the computer. The microcontroller programs and controls the analog front-end chip.

The 6950 provides the analog functions of the modem. It includes 8-bit digital-to-analog (D/A) and analog-to-digital (A/D) converters for translating the analog signals of the telephone line to the digital signals within the computer and digital signals to analog.

The TMS320 digital signal processor (DSP) handles all high-speed signal processing for the modem. This includes all modulation, demodulation, encoding, decoding, and adaptive equilization. The DSP also performs the scrambling and descrambling required for Bell 212A, V.22, and V.22bis. Finally, the DSP handles DTMF (Touch-Tone) dialing, answer-tone generation, and call-process signal monitoring.

Computer Interface

The modem card and the external modem port share Port 1 of the serial communications controller. Switching between the two devices is handled by the Misc GLU IC. If the internal modem is installed and enabled (through the Portable CDEV in the Control Panel), then the external modem port is unusable. To use the external port again, either remove the internal modem or select the external modem port through the Control Panel.

Sleep Mode

While the computer is in sleep mode, the modem consumes significantly less power—only the microcontroller and ring-detect circuitry are active. Maintaining power to the microcontroller and ring-detect circuitry allows the modem to alert the computer when the telelephone line is ringing and a call is coming in.

Resetting the Modem

Resetting the modem is accomplished by removing all power to the system, typing the command ATZ, or pressing the reset and interrupt switches.

Troubleshooting

Most problems with the internal modem occur during installation. Other problems occur only with certain baud rates, modes of operation, or telephone lines. To verify that the modem is operating correctly, Apple provides a diagnostic called *ModemTest™*, which verifies operation of all modem circuitry except the circuits that interface the modem to the telephone network. If a customer experiences problems when using a modem, *ModemTest* can isolate the fault to either the modem, the computer, or problems with the connection between the modem and the telephone network.

Setup and operating procedures for *ModemTest* can be found in *Apple Service Technical Procedures—Modems* in *Cross Family Peripherals*, Section 4, Diagnostics.

Additional troubleshooting information for the internal modems is provided in "Internal Modem Problems," in Section 4, Troubleshooting.

Note: The modem is analog and cannot be used with digital telephone systems.

❑ MACINTOSH PORTABLE DATA MODEMS

Installation

The following procedure covers the installation of the Macintosh Portable Data Modem 2400 and Int'l XP 2400.

Materials Required

Grounded workstation pad
Grounding wriststrap
Portable Data Modem 2400 card (US and Canada)
Int'l XP 2400 card (international)
Compatible DAA (international only)

Procedure

1. Unplug the power adapter from the computer.
2. Remove the rear cover and main battery.

CAUTION: *Remember to replace the battery cover after removing the main battery. Failure to replace the battery cover can damage the computer and modem.*

3. **Figure 6-A**. Remove the modem cap by pushing it out through the rear of the computer.
4. **Figure 6-B**. Locate the modem card connector.
5. **Figure 6-C**. Position the card over the connector and plug in the card. Make sure the card is on the right side of the modem gasket.
6. Remove the battery cover and replace the main battery.
7. Replace the rear cover.

Check-out

After installation is complete, verify the installation and operation of the modem by using the procedures described in *Apple Service Technical Procedures—Modems* in *Cross Family Peripherals*, Section 4, Diagnostics. You will use *ModemTest* to verify that the computer and modem are communicating and AppleLink to verify operation of the modem with the telephone network.

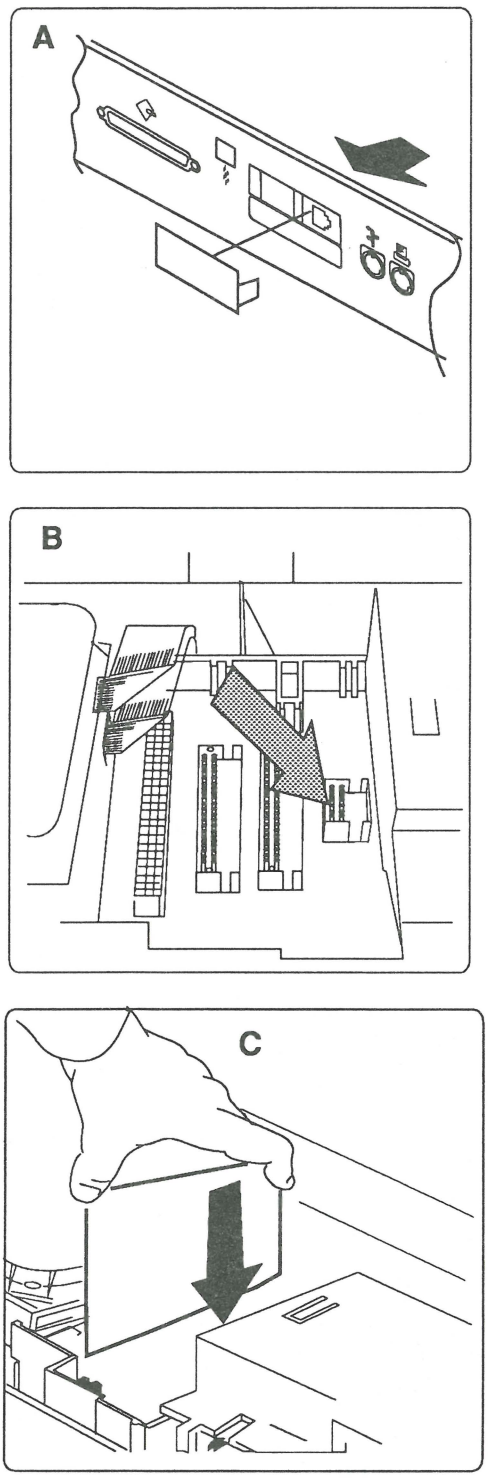


FIGURE 6

❑ MACINTOSH PORTABLE DATA MODEMS

Specifications

The following specifications apply to both the Portable Data Modem 2400 and Int'l XP 2400. Differences are noted where applicable.

Regulatory (Data Modem 2400 only)

FCC registration number:	BCGM0250
Ringer equivalence:	0.3B
Canadian load number:	9
Jack type:	USOC RJ-11 (US) CA 11 (Canada)

Communication

Protocol:	Asynchronous
Mode:	Full-duplex
Transmission rates:	300 bps (Bell 103) 1200 bps (CCITT V.22A/B and Bell 212A) 1200/75 bps (CCITT V.23–Int'l XP 2400 only) 2400 baud (CCITT V.22bis)
Data formats:	7 data bits with 1 stop bit and odd, even, or fixed mark or space parity 7 data bits with 2 stop bits and no parity 8 data bits with 1 stop bit and no parity
Error correction: (Int'l XP 2400 only)	Microcom Network Protocol (MNP) levels 4 and 5 provided by an option card

Telephone Interface

Tone:	Dual-tone multifrequency (DTMF)
Frequency tolerance:	±1%
Pulse:	
Duty cycle:	39%/61% or 33%/67% mark/break ratio
Dialing rate:	10 pps

Miscellaneous	Receiver dynamic range:	-10 dBm to -43 dBm full-duplex
	Frequency tolerance:	± 7 Hz
	Operating modes:	Auto-dial and manual/auto answer
Electrical	Power consumption:	525 milliwatts typical 750 milliwatts maximum 3 milliwatts in sleep mode
Environmental	Operating environment:	
	Ambient temperature:	10-50° C
	Relative humidity:	95% (noncondensing)

❑ RAM EXPANSION CARDS

Product Description

The RAM expansion cards are 1 MB and 3 MB RAM cards for the Macintosh Portable computer. The original 1 MB card uses 100-nsec low-power CMOS static RAMs. The newer 1 MB and 3 MB cards use 100-nsec low-power pseudostatic RAMs.

The static 1 MB RAM Expansion Card is shown in **Figure 7-A**. The pseudostatic 1 MB RAM Expansion Card is shown in **Figure 7-B**. The pseudostatic 3 MB RAM Expansion Card is shown in **Figure 7-C**.

Note that the pseudostatic and static RAM cards operate differently and are not interchangeable. Pseudostatic RAM expansion cards must be used in systems with a pseudostatic RAM logic board; the 1 MB RAM expansion card must be used in systems with a static RAM logic board.

Pseudostatic RAM cards can be identified by a tab in the center of the 50-pin connector. (This tab prevents a pseudostatic RAM card from being installed in static RAM logic boards.) Pseudostatic logic boards have a corresponding notch in the center of the RAM expansion connector.

Static RAM cards and logic boards do not have any tabs or notches. It it important, therefore, to use caution when installing the 1 MB static RAM Expansion Card in a Macintosh Portable. If the RAM expansion connector in the computer has a notch (which indicates a pseudostatic logic board), do not install a static RAM card.

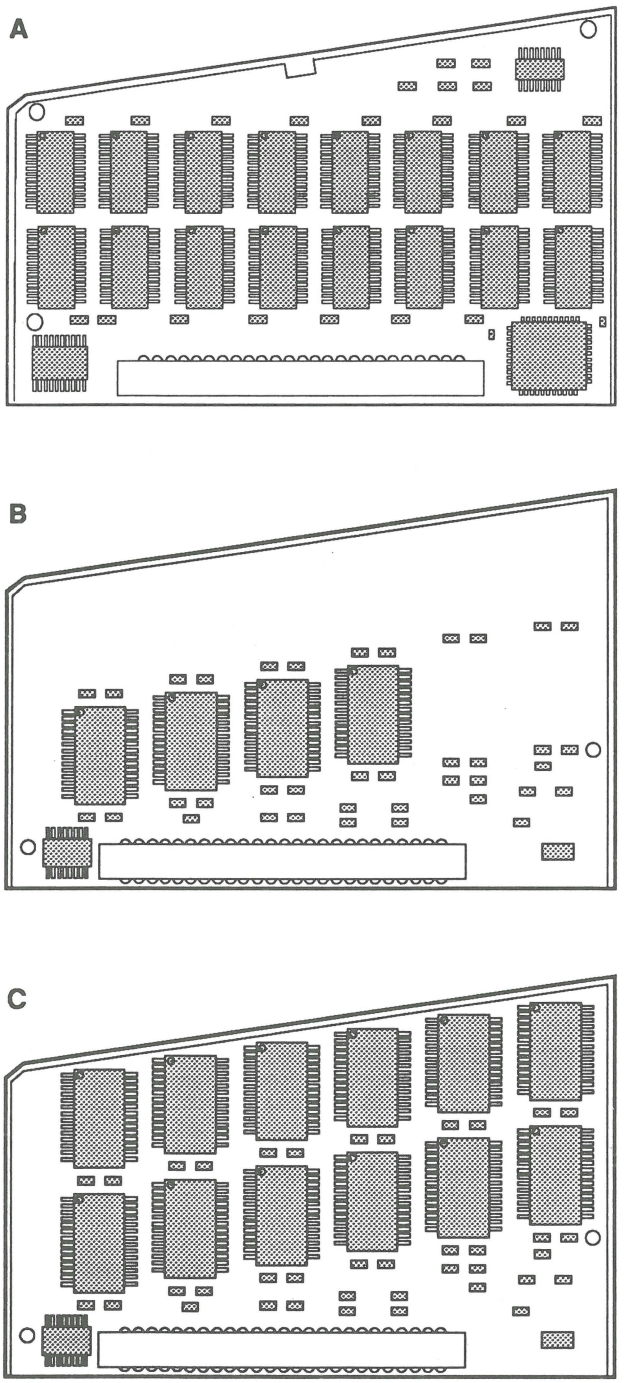


FIGURE 7

❑ RAM EXPANSION CARDS

Installation

The following procedure covers the installation and check-out of the memory expansion cards.

Materials Required

Grounded workstation pad
Grounding wriststrap
1 MB or 3 MB RAM Expansion Card

Procedure

1. Disconnect the power adapter.
2. Remove the rear cover and main battery.

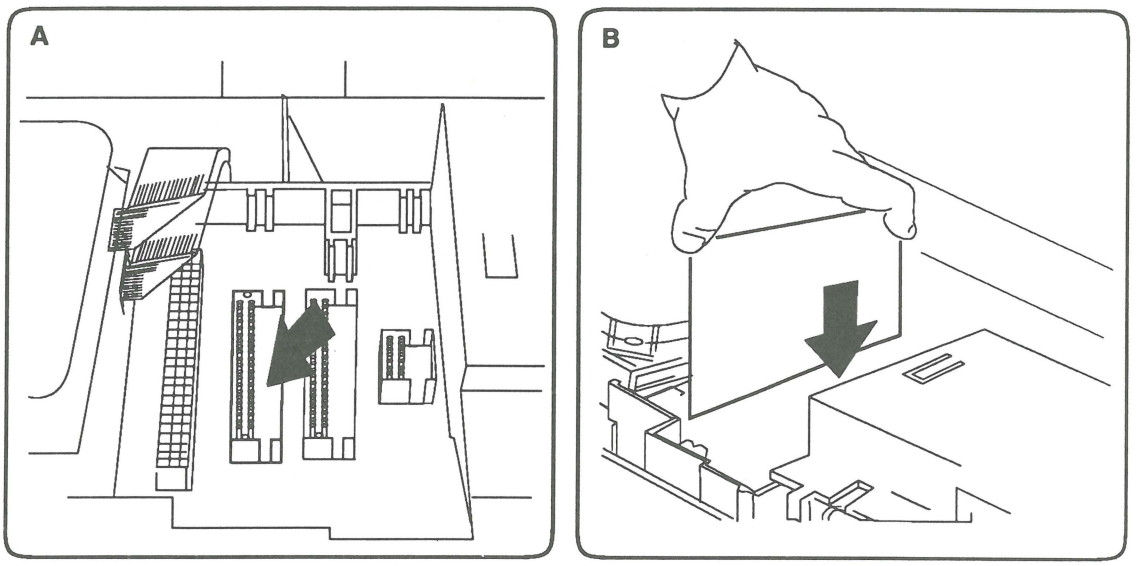
CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover. Failure to replace the battery cover can damage the computer.*

3. **Figure 8-A**. Locate the RAM expansion connector. Note whether the connector has a notch. If it does, a pseudostatic card must be used. Do not install a tabless, 1 MB RAM Expansion Card.
4. **Figure 8-B**. Position the card over the connector and plug the card in.
5. Remove the battery cover and replace the main battery.
6. Replace the rear cover.

Check-out

1. Turn on the computer by pressing any key except <Caps Lock>.
2. **Figure 8-C**. Pull down the Apple menu and select **About the Finder**.
3. Check that the amount of RAM ("Total Memory") is 2048K (1 MB RAM Expansion Card) or 4096K (3 MB RAM Expansion Card).

   If the amount of RAM is not correct, proceed to "Troubleshooting."


A
B

C

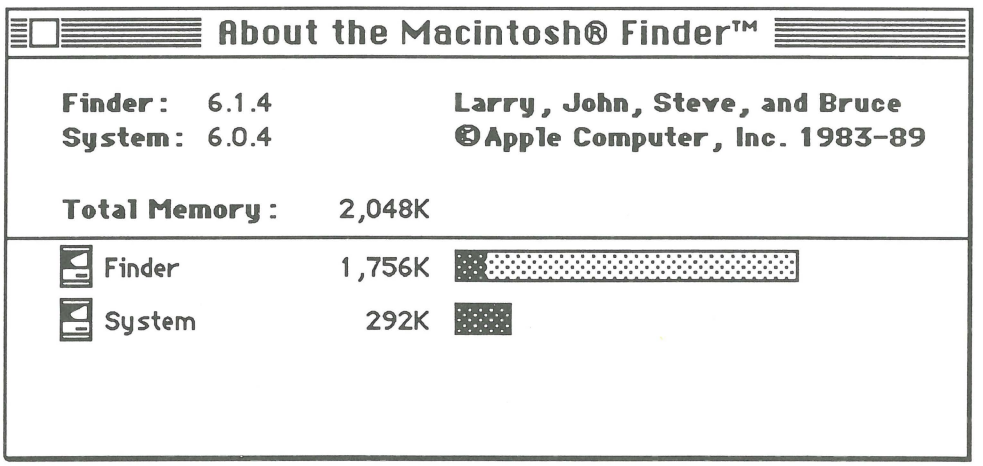

About the Macintosh® Finder™
Finder: 6.1.4
System: 6.0.4
Larry, John, Steve, and Bruce
©Apple Computer, Inc. 1983-89
Total Memory: 2,048K
Finder 1,756K
System 292K

FIGURE 8

❑ RAM EXPANSION CARDS

Troubleshooting

Refer to **Figure 9** while performing troubleshooting of the RAM expansion card.

1. **If the amount of RAM indicated in "About the Finder" is not correct** and the system has a pseudostatic RAM logic board (keyed RAM expansion connector), verify that the RAM expansion card is also keyed. If the card is not, install a pseudostatic RAM card.

2. Replace the RAM expansion card.

3. If the amount of RAM indicated is still not correct, replace the logic board.

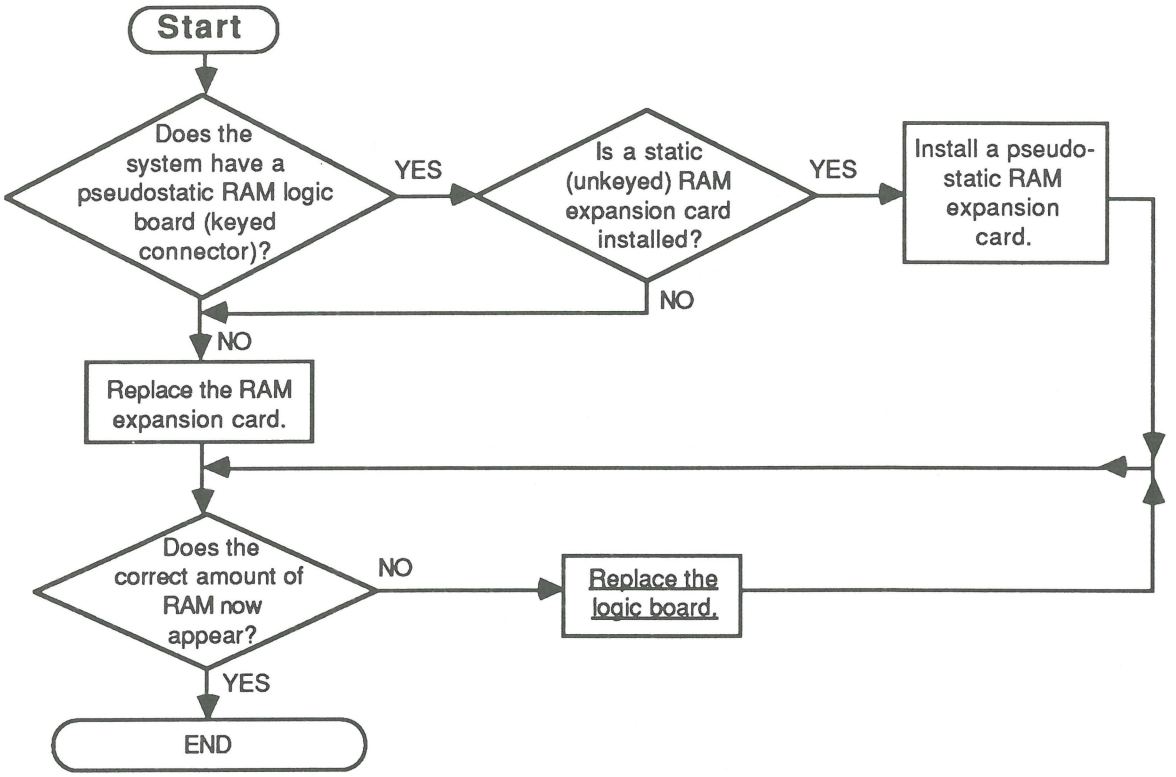

Start
Does the system have a pseudostatic RAM logic board (keyed connector)?
YES
Is a static (unkeyed) RAM expansion card installed?
YES
Install a pseudo-static RAM expansion card.
NO
NO
Replace the RAM expansion card.
Does the correct amount of RAM now appear?
NO
Replace the logic board.
YES
END

FIGURE 9

❑ RECONFIGURING INPUT DEVICES

A unique feature of the Macintosh Portable is the ability to reconfigure the various input devices—the keyboard, trackball, and optional numeric keypad. You can change both the combination and position of the input devices.

When the Macintosh Portable is shipped from Apple, it is set up with a keyboard and trackball. The keyboard is on the left side and the trackball is on the right.

Figure 10-A shows the various ways the computer can be configured.

Materials Required

Jeweler's screwdriver
Grounded workstation pad
Grounding wriststrap
Numeric keypad, if the trackball is being replaced by a numeric keypad

Procedure

1. Disconnect the power adapter.

2. Remove the rear cover, main battery, and keyboard cover.

   CAUTION: *Remember to replace the battery cover after removing the main battery and before you remove the keyboard cover. Failure to replace the battery cover can damage the computer.*

3. **Figures 10-B1, 10-B2, and 10-B3. If you are exchanging the trackball and numeric keypad,** disconnect the flat cable of the input device you are exchanging.

   If you are changing the positions of two input devices, disconnect the flat cable of both devices.

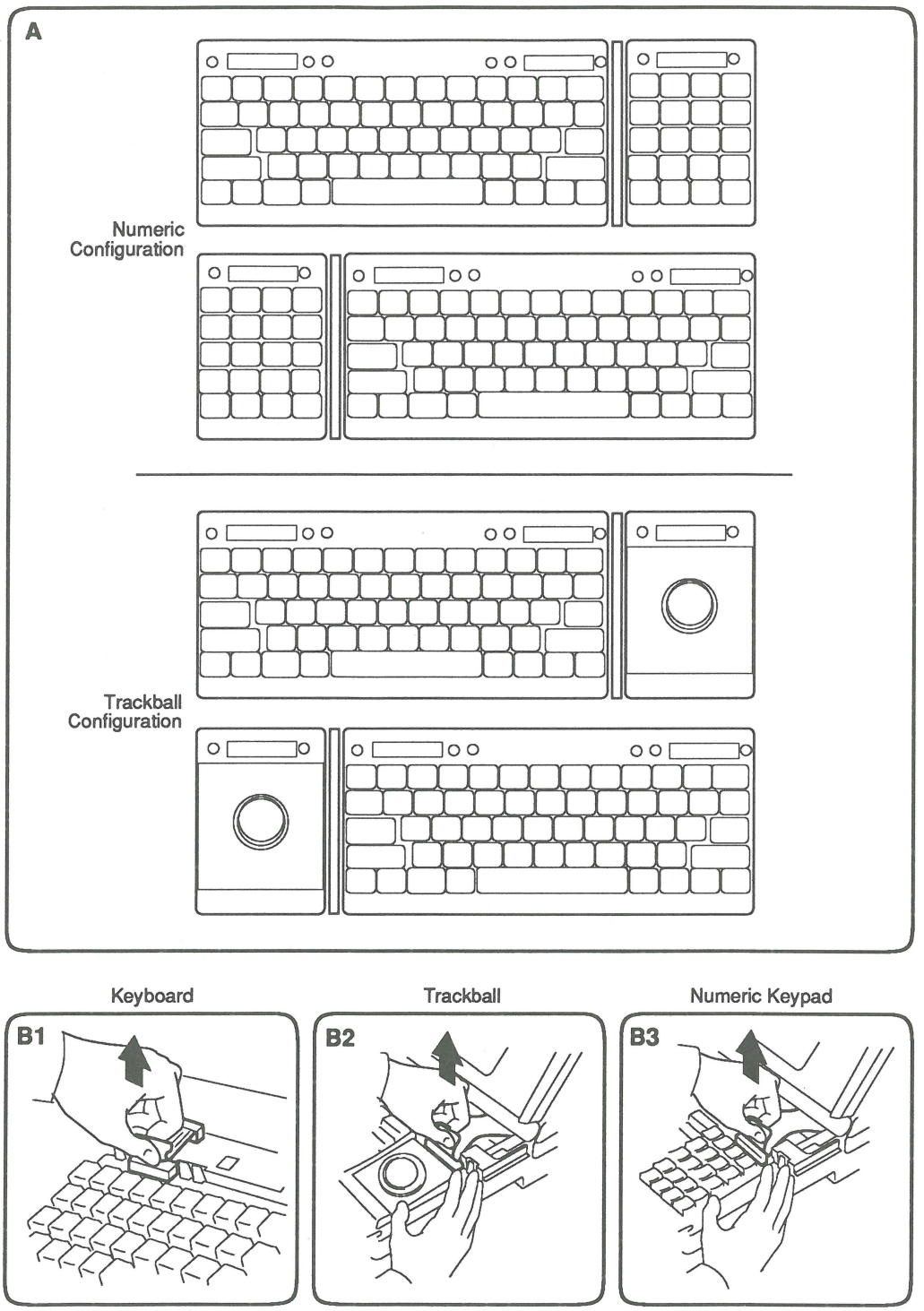

A
Numeric Configuration
Trackball Configuration
Keyboard
Trackball
Numeric Keypad
B1
B2
B3

FIGURE 10

❑ RECONFIGURING INPUT DEVICES

4. **Figures 11-A1, 11-A2, and 11-A3**. Starting at one side of the input device to be removed, simultaneously press back on each plastic tab securing the device to the case and lift the device. When all the tabs are released, remove the device from the computer.

5. **If you are changing input device positions**, repeat step 4 for the other device.

6. **If you are changing device positions**, reverse the position of the keyboard spacer.

   a) **Figure 11-B1**. The **keyboard spacer** is on the **right** when the **keyboard** is on the **left**.

   b) **Figure 11-B2**. The **keyboard spacer** is on the **left** when the **keyboard** is on the **right**.

7. **Figures 11-C1, 11-C2, and 11-C3**. Place the front of the device in the guides at the front of the computer. Press down the rear of the device until it snaps in place.

8. **Figures 11-D1, 11-D2, and 11-D3**. Connect the flat cable to the device.

9. **If you changed device positions**, repeat steps 7 and 8 for the other device.

10. Replace the keyboard cover, main battery, and rear cover.

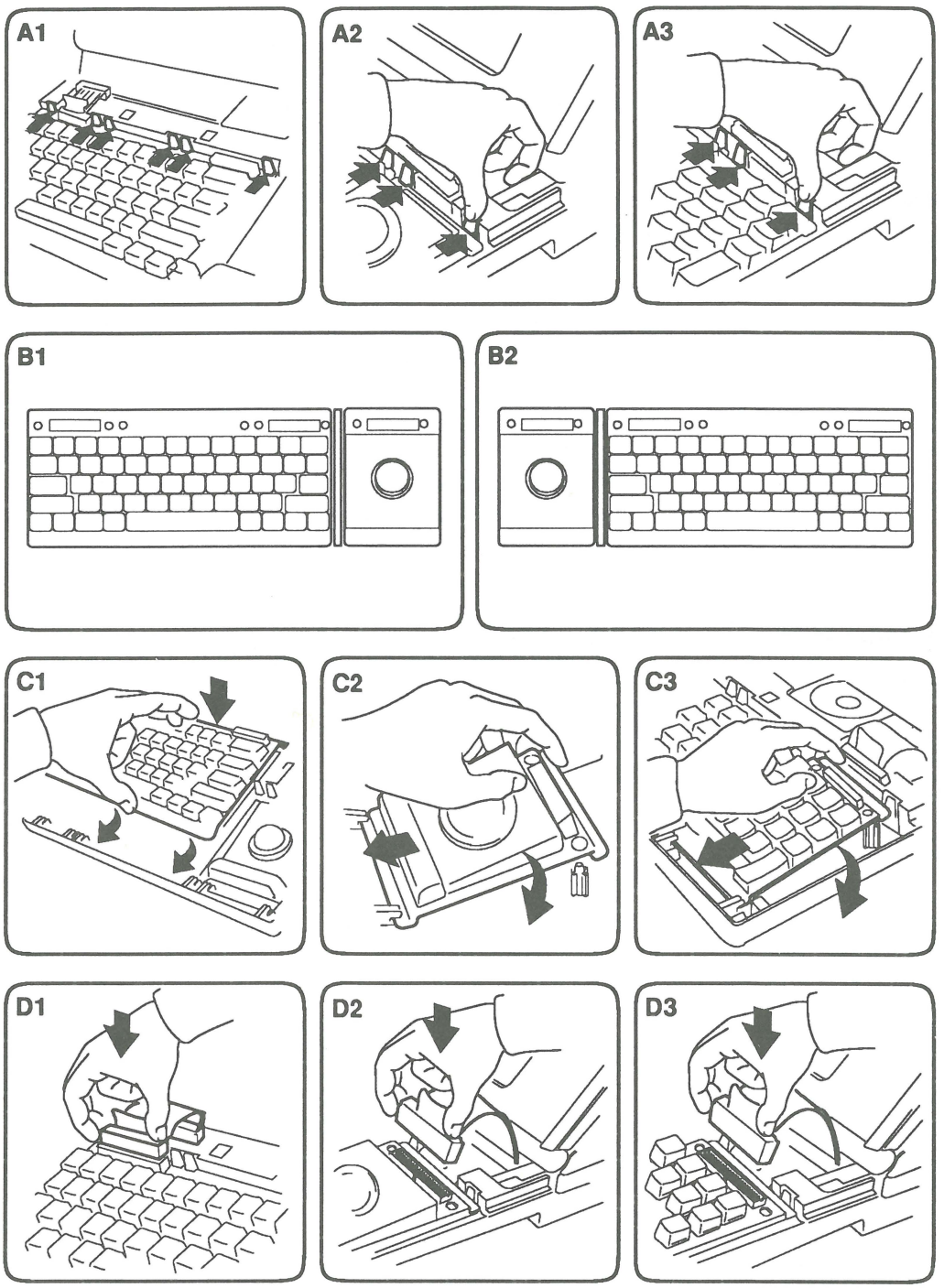


FIGURE 11

❑ BATTERY RECHARGER

Product Description

The battery recharger is an optional external battery recharger. With the purchase of a second battery, the user can charge a second battery while using the first battery in the computer. This option provides a fully charged battery whenever required.

Operation

The battery recharger is set up as shown in **Figure 12-A**.

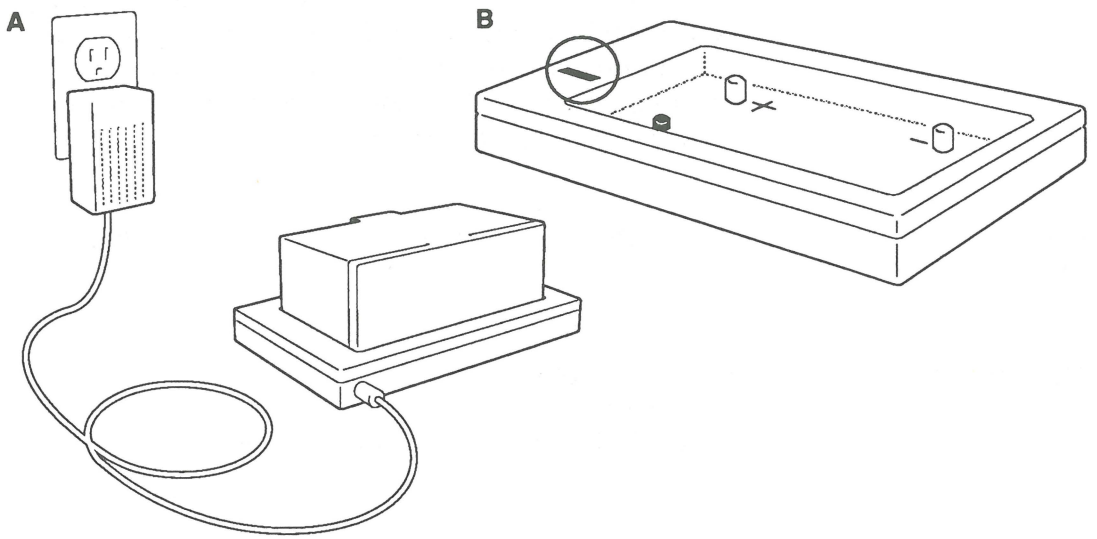
LED

Figure 12-B. An LED is provided to indicate the progress of charging the battery.

- **Yellow** – the battery is charging
- **Green** – the battery is charged to at least 80% of capacity and is ready to use
- **Off** – the charger is unplugged, the battery is bad, or the charger is defective

Troubleshooting

Figure 12-C. Use the flowchart to troubleshoot problems with the battery recharger.


A
B

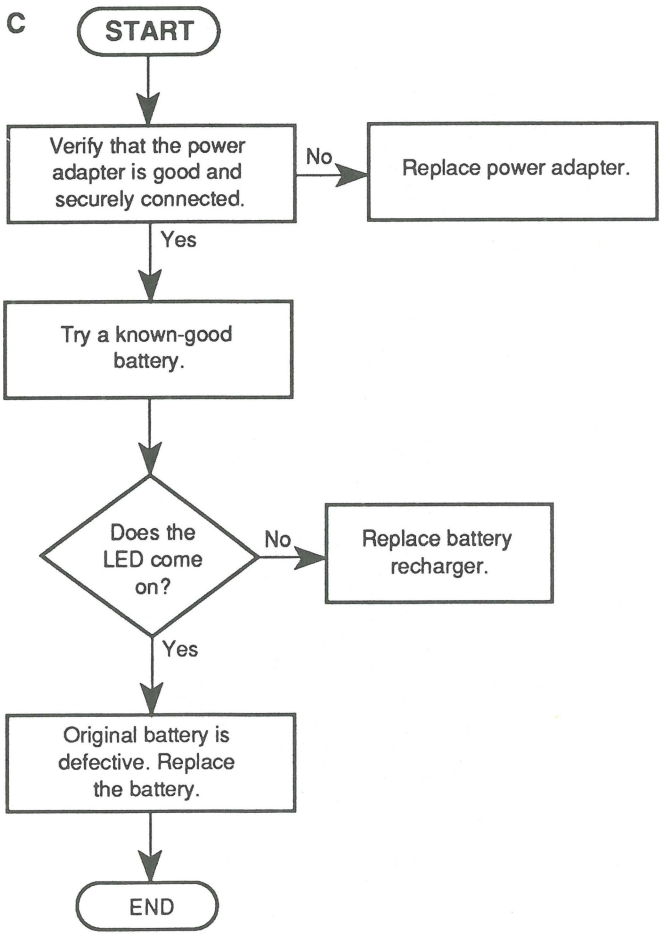

C
START
Verify that the power adapter is good and securely connected.
No
Replace power adapter.
Yes
Try a known-good battery.
Does the LED come on?
No
Replace battery recharger.
Yes
Original battery is defective. Replace the battery.
END

FIGURE 12

❑ TRACKBALL PREVENTIVE MAINTENANCE

Most problems with trackball operation can be easily avoided by keeping the trackball clean. Operate the trackball only when your hands are clean and dry. Encourage users to clean the trackball once a month. Use the following procedure:

Cleaning Procedure

Perform the following steps to clean the trackball.

Materials Required

Clean, dry cloth
Cotton swab
Isopropyl alcohol or tape head cleaner

Procedure

1. **Figure 13**. Rotate the trackball retainer counterclockwise as far as it will go and remove the retainer and trackball.

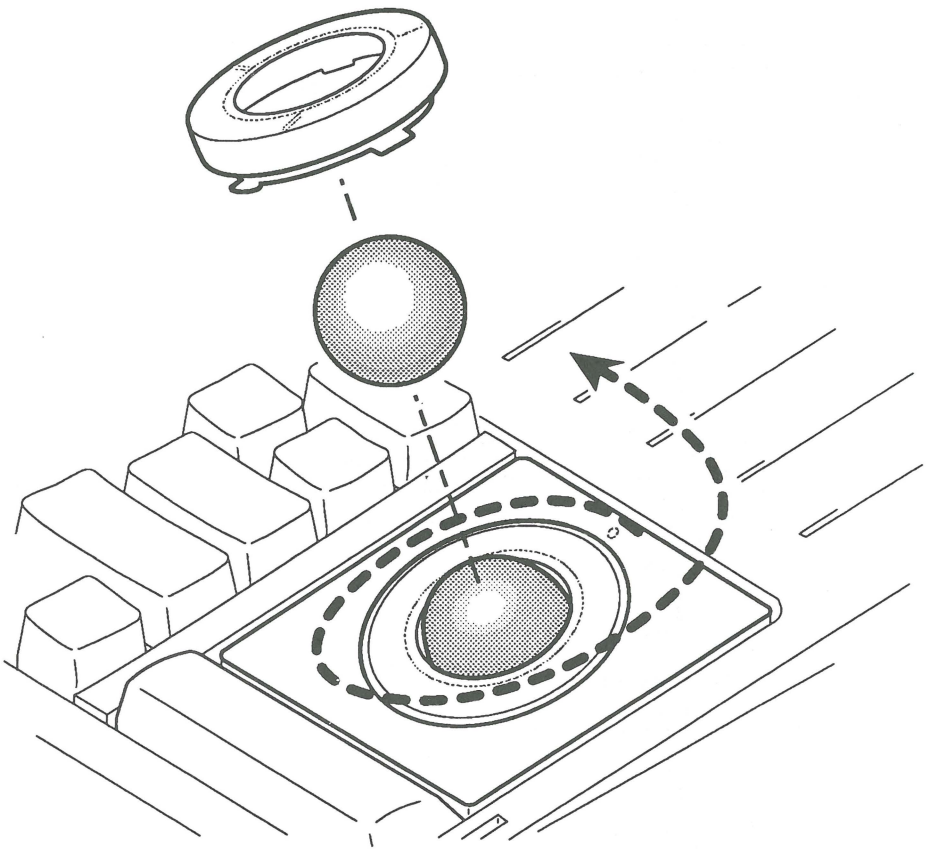


FIGURE 13

2. Gently blow out any dust that has collected inside the trackball assembly.

3. **Figure 14.** Locate the rollers inside the trackball assembly.

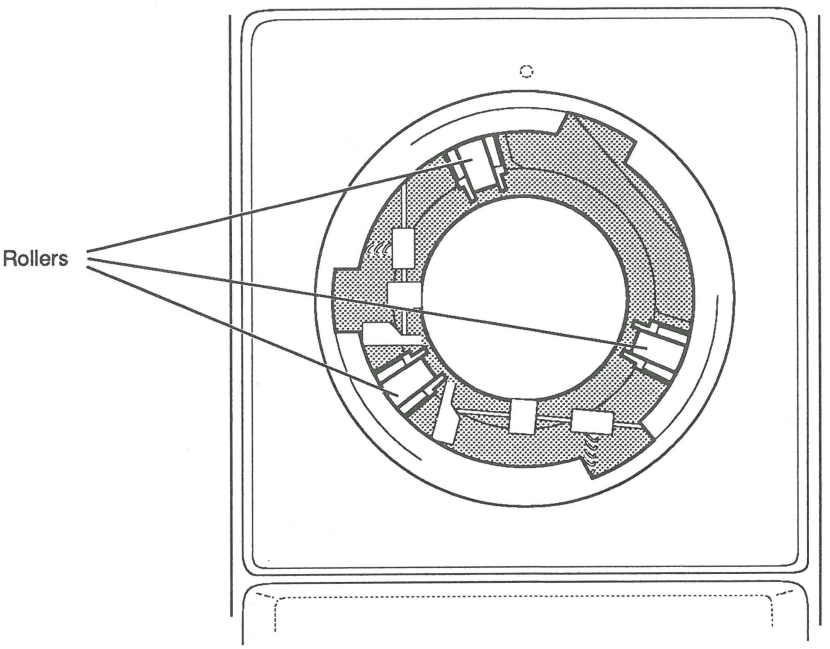


FIGURE 14

4. Using a cotton swab moistened with alcohol or tape head cleaner, gently wipe off any oil or dust that has collected on the rollers. Rotate the rollers to clean all surfaces.

CAUTION: *When cleaning the trackball, do not use tissue or anything that can leave lint, and do not use cleaning liquid.*

5. Clean the trackball by wiping it with a soft, dry cloth.

6. Replace the trackball inside the trackball assembly.

7. Place the trackball retainer in position on the trackball assembly and rotate the retainer clockwise until the retainer seats correctly. Continue to rotate the ring clockwise as far as it will go.

❑ BACKLIT DISPLAY UPGRADE

Introduction

The Macintosh Portable Backlit Display Upgrade Kit enables you to upgrade a Macintosh Portable that has a nonbacklit display.

The upgrade provides the same resolution (640 horizontal pixels x 400 vertical lines) as does the nonbacklit display. The backlit display uses a 10-inch flat-panel active-matrix liquid crystal display (LCD). The lighting technology is cold-cathode fluorescent and is adjustable by means of a Control Panel device (CDEV).

CAUTION: *Before handling or installing the ROM card, read and observe the electrostatic discharge precautions under the* You Oughta Know *Tab.*

What's in the Kit

The Macintosh Portable Backlit Display Upgrade Kit consists of the following items:

- ROM card
- Macintosh Portable backlit display assembly with 8-wire connector cable
- Macintosh system software 6.0.7
- Macintosh Portable Upgrade disk (**do not use**; see Caution below)

CAUTION: *The software required to perform this upgrade is included in the March 1991 mailing of the* Macintosh Family Technical Procedures. *Do* ***not*** *use the software provided with the Macintosh Portable Backlit Display Upgrade Kit.*

BACKLIT DISPLAY UPGRADE ❑

Installation Procedure

CAUTION: *If a RAM disk is present, be sure to save its contents before beginning Take-Apart. Otherwise, the contents of the RAM disk will be lost.*

1. Upgrade the Macintosh Portable software by using the disks provided in the March 1991 mailing of the *Macintosh Family Technical Procedures*—do **not** use the software provided with the upgrade kit. Follow the Macintosh Portable Backlit Display Upgrade Kit instructions or refer to the Basics section for general system software installation instructions.

   Note: To comply with software license regulations, give the software provided with the Macintosh Portable Backlit Display Upgrade Kit to the customer in its unopened box.

2. Unplug the power adapter.

3. Remove the rear cover.

4. Remove the main battery.

5. Replace the main battery cover.

CAUTION: *Failure to replace the battery cover can damage the computer.*

6. Remove the keyboard cover.

7. Remove the old (nonbacklit) display assembly from the Macintosh Portable.

8. Using ESD precautions, remove the ROM card from its static-shielded bag.

❑ BACKLIT DISPLAY UPGRADE

9. **Figure 15-A**. Connect the backlit display 8-wire cable connector to the ROM card.

10. **Figure 15-B**. Insert the ROM card into the ROM slot at the back of the logic board. The card fits only one way—with the connector facing forward.

11. **Figure 15-B**. Wrap the 8-wire cable around the front of the center post.

12. Install the backlit display assembly (use the nonbacklit display assembly Replace procedures in Take-Apart).

13. Replace the keyboard cover.

14. Replace the main battery.

15. Replace the main battery cover.

16. Replace the rear cover.

17. Return the Macintosh Portable nonbacklit display assembly to Apple for credit. See the instructions in the Macintosh Portable Backlit Display Upgrade Kit.

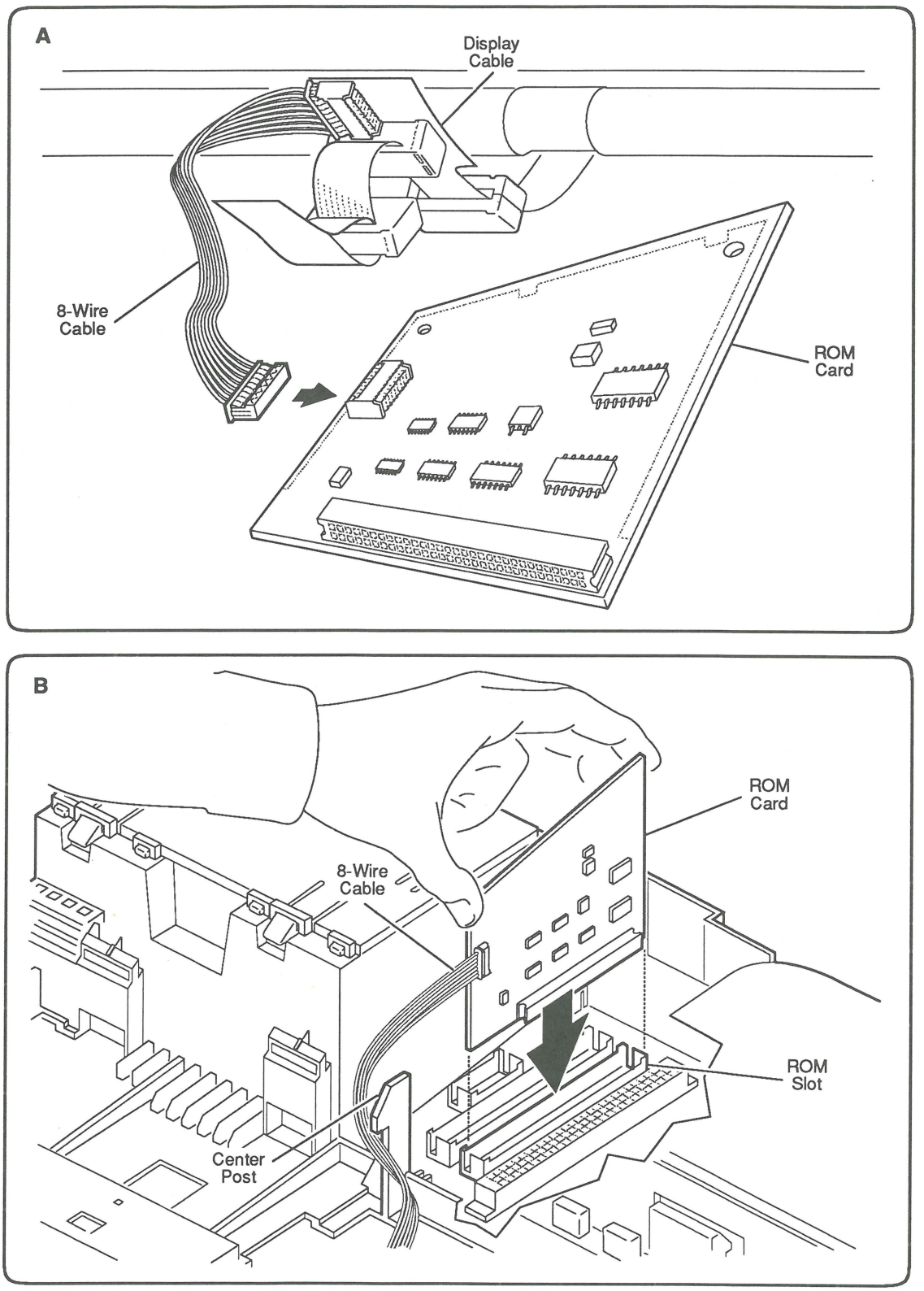

A
Display Cable
8-Wire Cable
ROM Card
B
ROM Card
8-Wire Cable
ROM Slot
Center Post

FIGURE 15

Apple Technical Procedures

Macintosh Portable

Illustrated Parts List

❑ CONTENTS

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh Portable, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

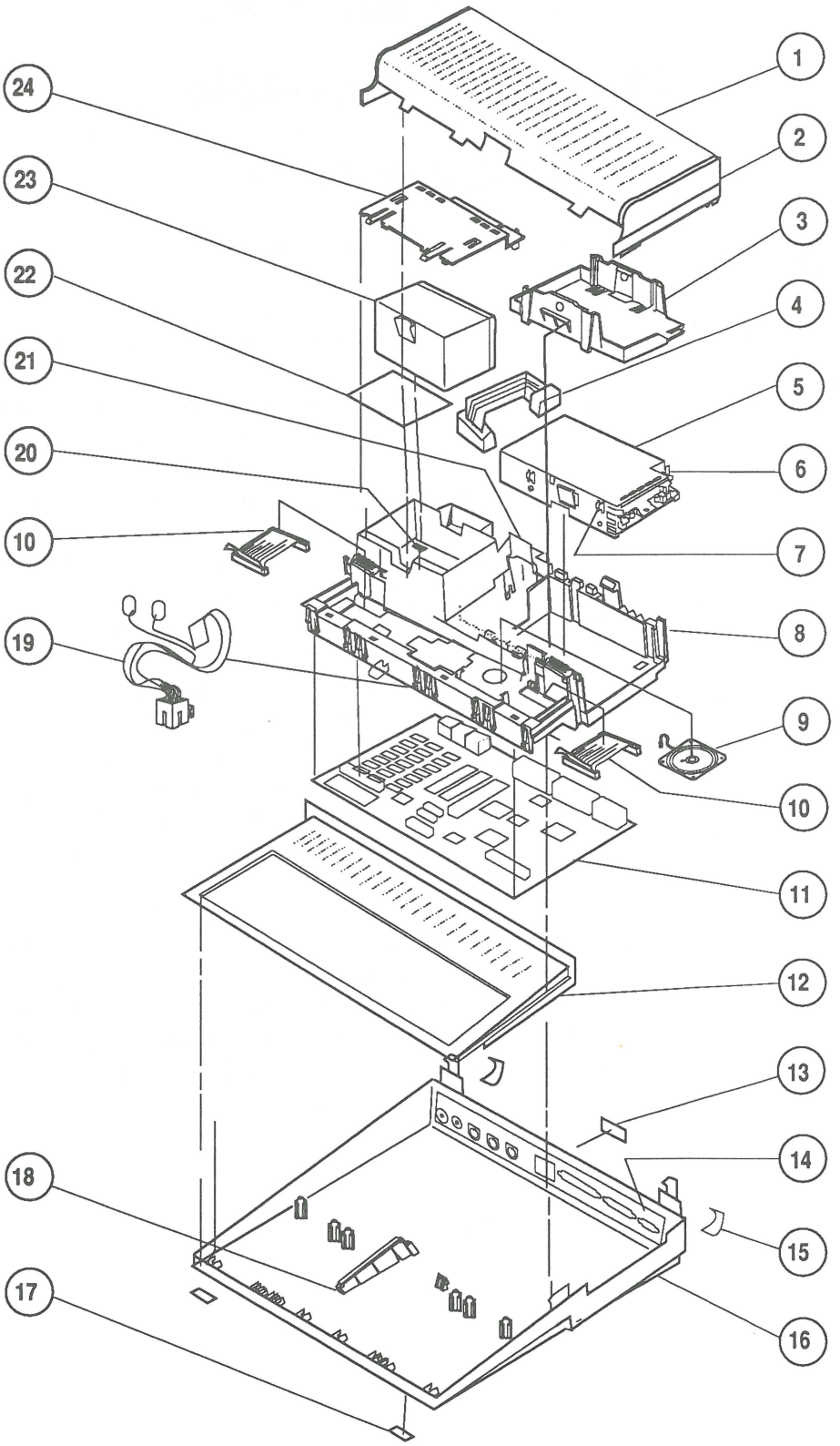


FIGURE 1

❑ MACINTOSH PORTABLE—SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	630-5687	Rear Cover
2	810-1096	Standard Bezel
3	815-1110	Floppy Retainer
4	590-0501	Cable from FDHD SuperDrive to Logic Board
5	805-0961	FDHD SuperDrive Shield
6	661-0474	FDHD SuperDrive Disk Drive
7	844-0018	FDHD SuperDrive Screw
8	630-5684	Subframe Assembly
9	600-0406	Speaker
10	590-0507	Cable from Keyboard/Trackball/Numeric Keypad to Logic Board
11	661-0470	Logic Board, Static RAM
	661-1610	Logic Board, Pseudostatic RAM
12	815-1059	Keyboard Cover
13	815-1111	Modem Cap
14	805-0973	RFI Foam Gasket
15	865-0060	Corner Foot
16	630-5844	Bottom Case
17	865-0054	Flat Foot
18	815-1093	Keyboard Spacer
19	600-0425	Wire Harness Assembly
20	805-0970	Battery Connector
21	805-0976	Modem RFI Gasket
22	865-0068	Battery Insulator
23	076-0376	Battery Pack (6V)
24	630-5723	Battery Cover

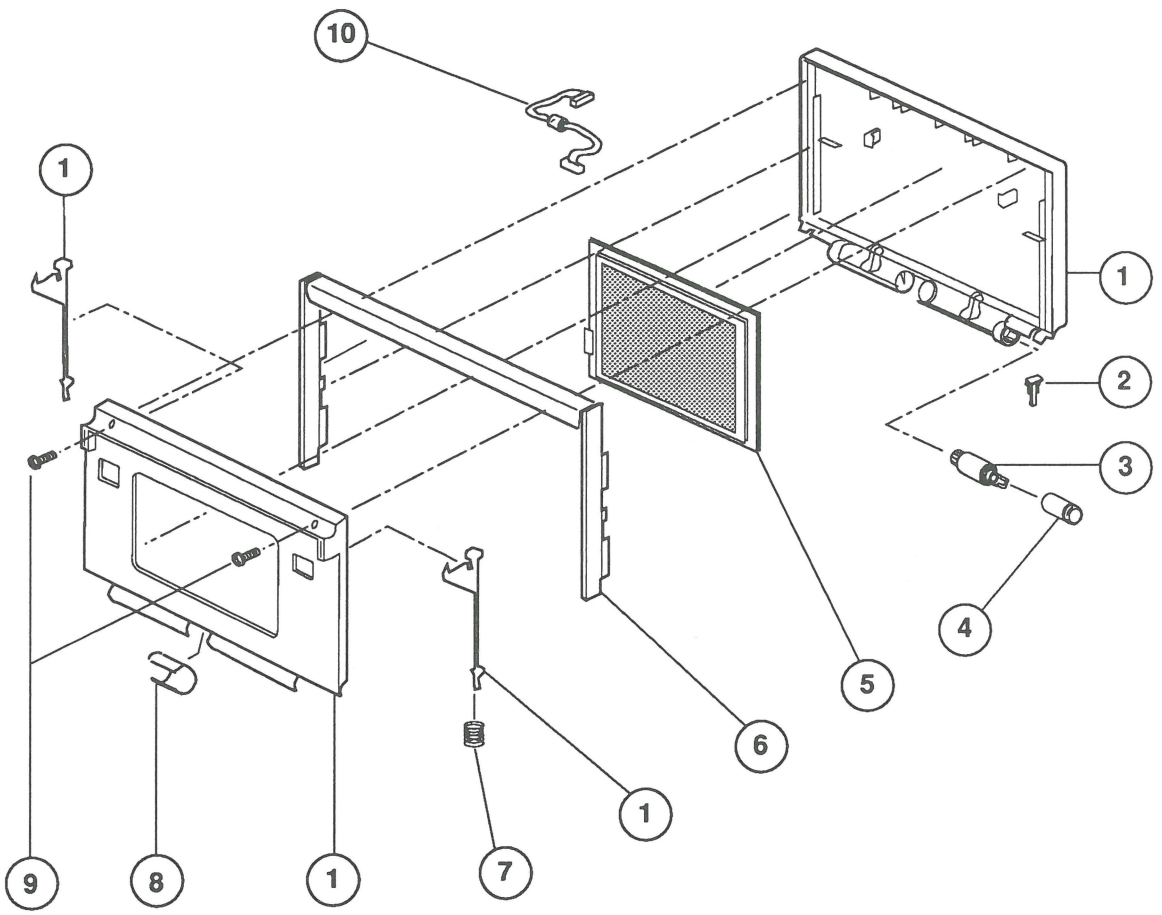


FIGURE 2

❑ NONBACKLIT DISPLAY ASSEMBLY (Figure 2)

Item	Part No.	Description
1	652-0604	Display Housing Assembly
2	815-1109	Clutch Retainer
3	699-5070	Clutch Mechanism
4	815-1098	Clutch Cover
5	661-0473	LCD Display, Nonbacklit
6	630-5071	Case Handle
7	805-1120	Latch Spring
8	815-1108	Center Pivot Cover
9	450-0505	Machine Screw, Platinum
10	590-0502	Display Cable

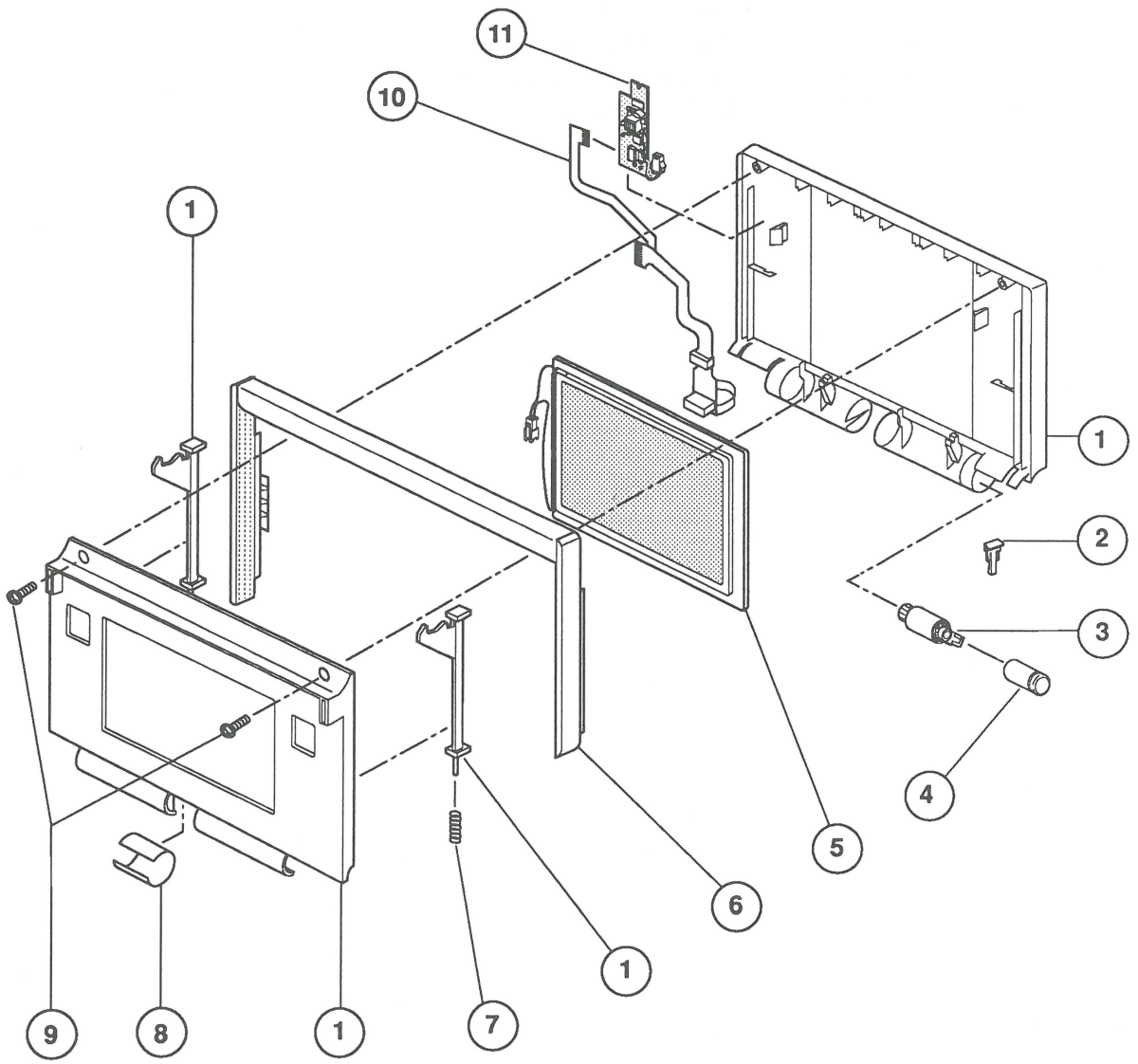


FIGURE 3

❑ BACKLIT DISPLAY ASSEMBLY (Figure 3)

Item	Part No.	Description
1	652-0605	Display Housing Assembly
2	815-1109	Clutch Retainer
3	699-5070	Clutch Mechanism
4	815-1098	Clutch Cover
5	661-0647	LCD Display, Backlit
6	630-5071	Case Handle
7	805-1120	Latch Spring
8	815-1108	Center Pivot Cover
9	450-0505	Machine Screw, Platinum
10	630-6280	Display Cable
11	699-0515	Inverter PCA

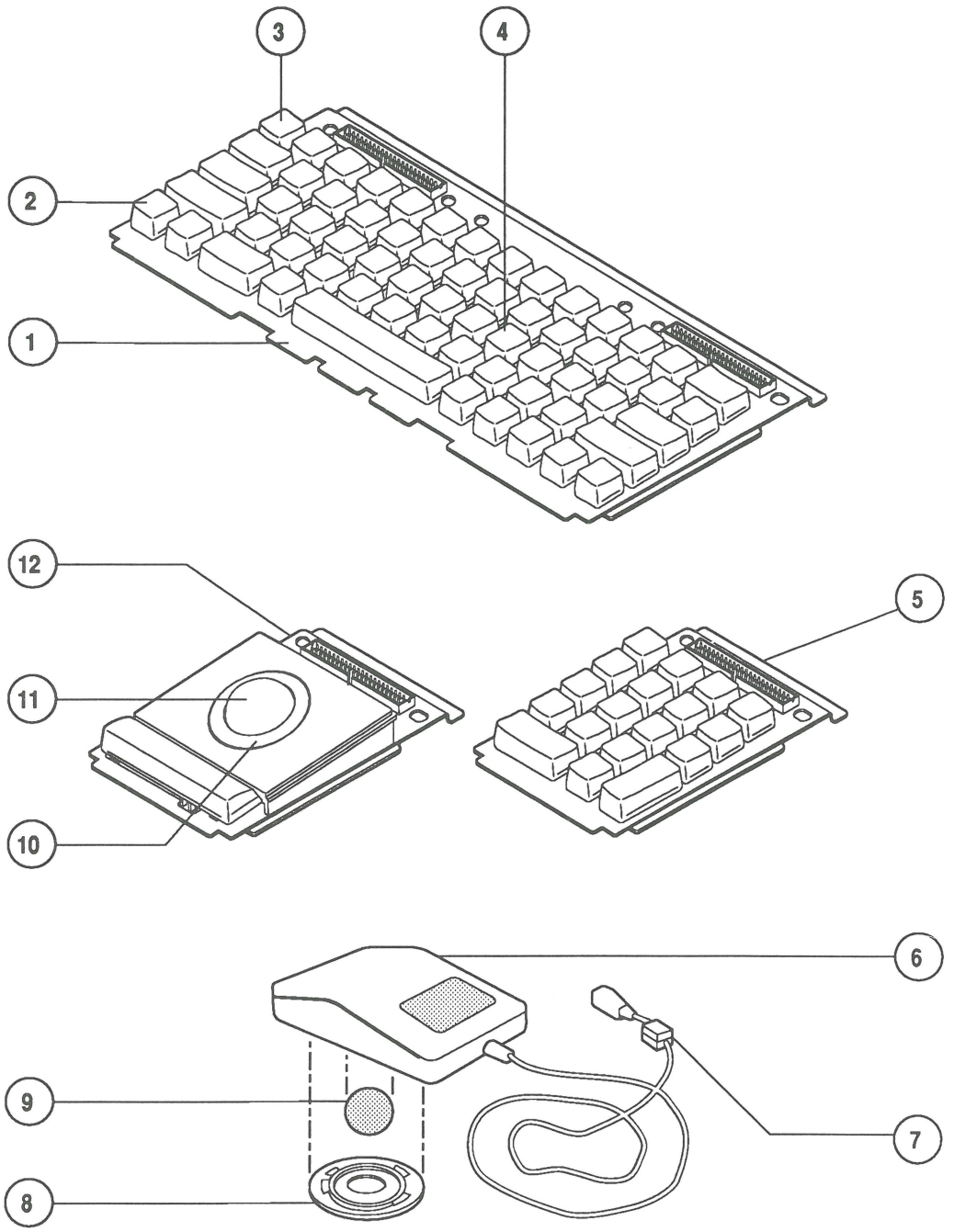


FIGURE 4

❑ INPUT DEVICES (Figure 4)

Item	Part No.	Description
1	661-0476	Keyboard, Original
	661-1612	Keyboard, Lightweight
	B661-0476	Keyboard, British, Original
	B661-1612	Keyboard, British, Lightweight
	C661-0476	Keyboard, French Canadian, Original
	C661-1612	Keyboard, French Canadian, Lightweight
	D661-0476	Keyboard, German, Original
	D661-1612	Keyboard, German, Lightweight
	E661-0476	Keyboard, Spanish, Original
	E661-1612	Keyboard, Spanish, Lightweight
	F661-0476	Keyboard, French, Original
	F661-1612	Keyboard, French, Lightweight
	S661-0476	Keyboard, Swedish, Original
	S661-1612	Keyboard, Swedish, Lightweight
	T661-0476	Keyboard, Italian, Original
	T661-1612	Keyboard, Italian, Lightweight
2	815-1132	Locking Keyswitch
3	076-0226	Keyswitch Set (10/pack), Original Keyboard
	076-0387	Keyswitch Set (10/pack), Lightweight Keyboard
4	658-7136	Keycap Set
5	661-0477	Numeric Keypad, Original
	661-1611	Numeric Keypad, Lightweight
	PA661-0477	Numeric Keypad, International PA Version, Original
	PA661-1611	Numeric Keypad, International PA Version, Lightweight
	Z661-0477	Numeric Keypad, International Z Version, Original
	Z661-1611	Numeric Keypad, International Z Version, Lightweight
6	661-0585	Low-Power Mouse
7	612-5019	Ferrite Bead, Low-Power Mouse
8	076-0231	Retainer, ADB Mouse Ball (38 mm diameter)
9	699-8038	Mouse Ball (21.9 mm diameter)
10	815-1134	Trackball Retainer
11	815-1133	Trackball Ball
12	661-0475	Trackball Assembly

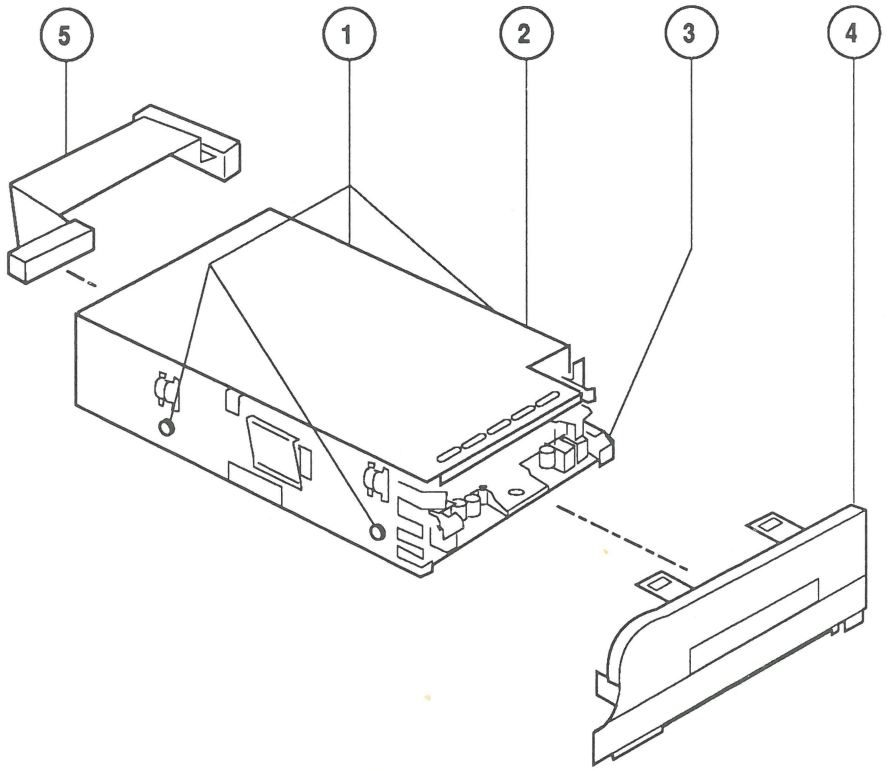


FIGURE 5

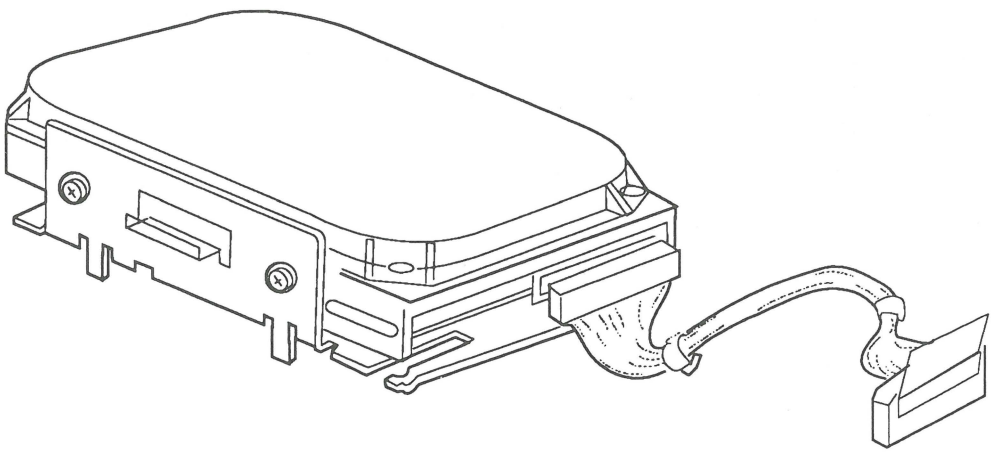


FIGURE 6

❑ UPPER FDHD SUPERDRIVE DISK DRIVE (Figure 5)

Item	Part No.	Description
1	844-0018	FDHD SuperDrive Screw (4)
2	805-0961	FDHD SuperDrive Shield
3	661-0474	FDHD SuperDrive Disk Drive
4	815-1092	Floppy Bezel
5	590-0501	Cable from FDHD SuperDrive to Logic Board

❑ SCSI HARD DISK DRIVE (Figure 6)

Item	Part No.	Description
–	661-0540	HDA, 3.5-inch, 40 MB, SCSI

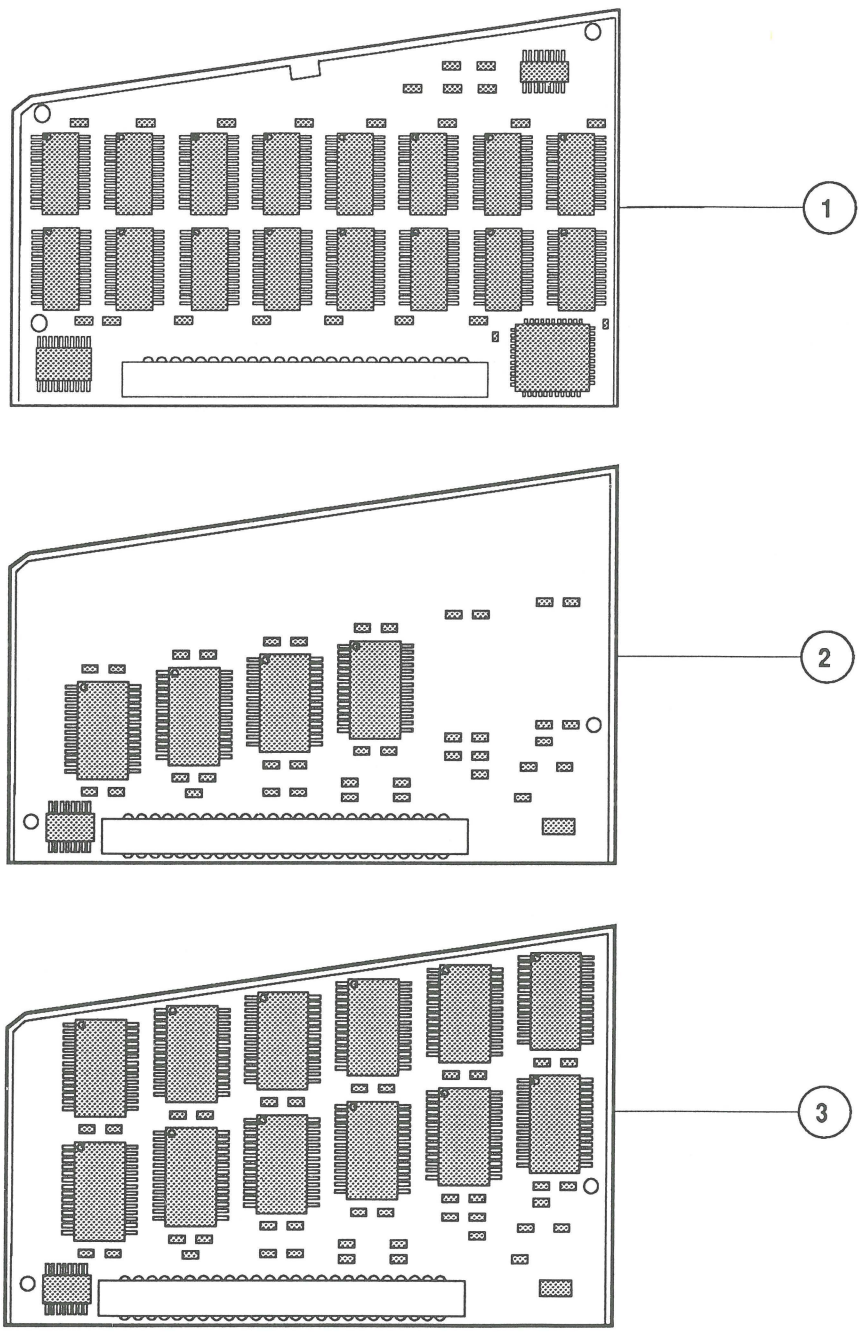


FIGURE 7

❑ RAM EXPANSION CARDS (Figure 7)

Item	Part No.	Description
1	661-0480	Static RAM Card, 1 MB
2	661-1614	Pseudostatic RAM Card, 1 MB
3	661-1613	Pseudostatic RAM Card, 3 MB

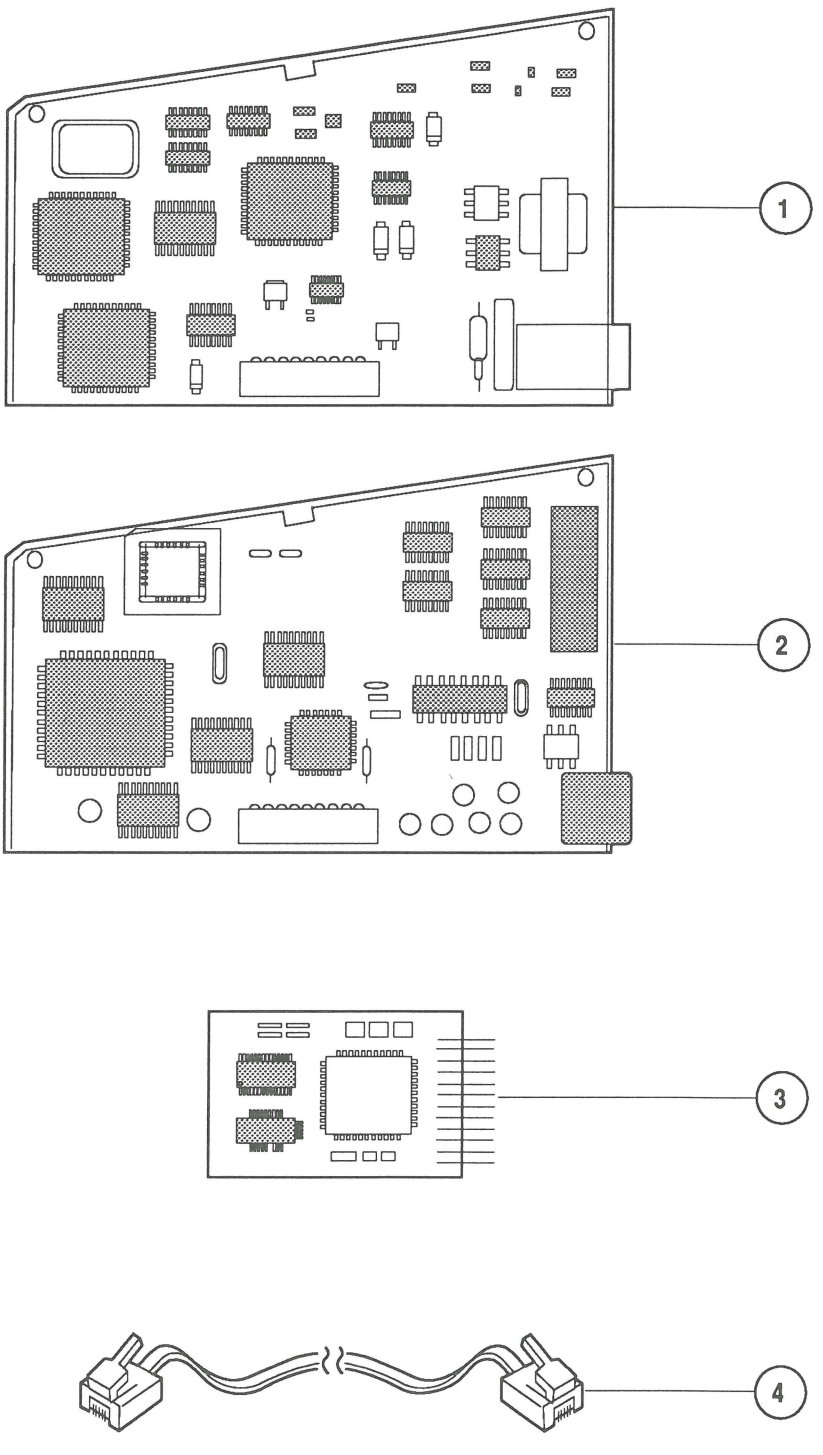


FIGURE 8

❑ INTERNAL MODEMS (Figure 8)

Item	Part No.	Description
1	661-0468	Data Modem 2400
2	661-0465	International XP 2400 Internal Modem*
–	D661-0465	International XP 2400 Internal Modem, Germany*
3	661-0588	MNP Board, International XP 2400 Modem*
4	590-0590	Telephone Cable, U.S.

***Note:** These items are not available in the U.S. The Data Access Arrangement and cables for the Int'l XP 2400 can be found on the following page.

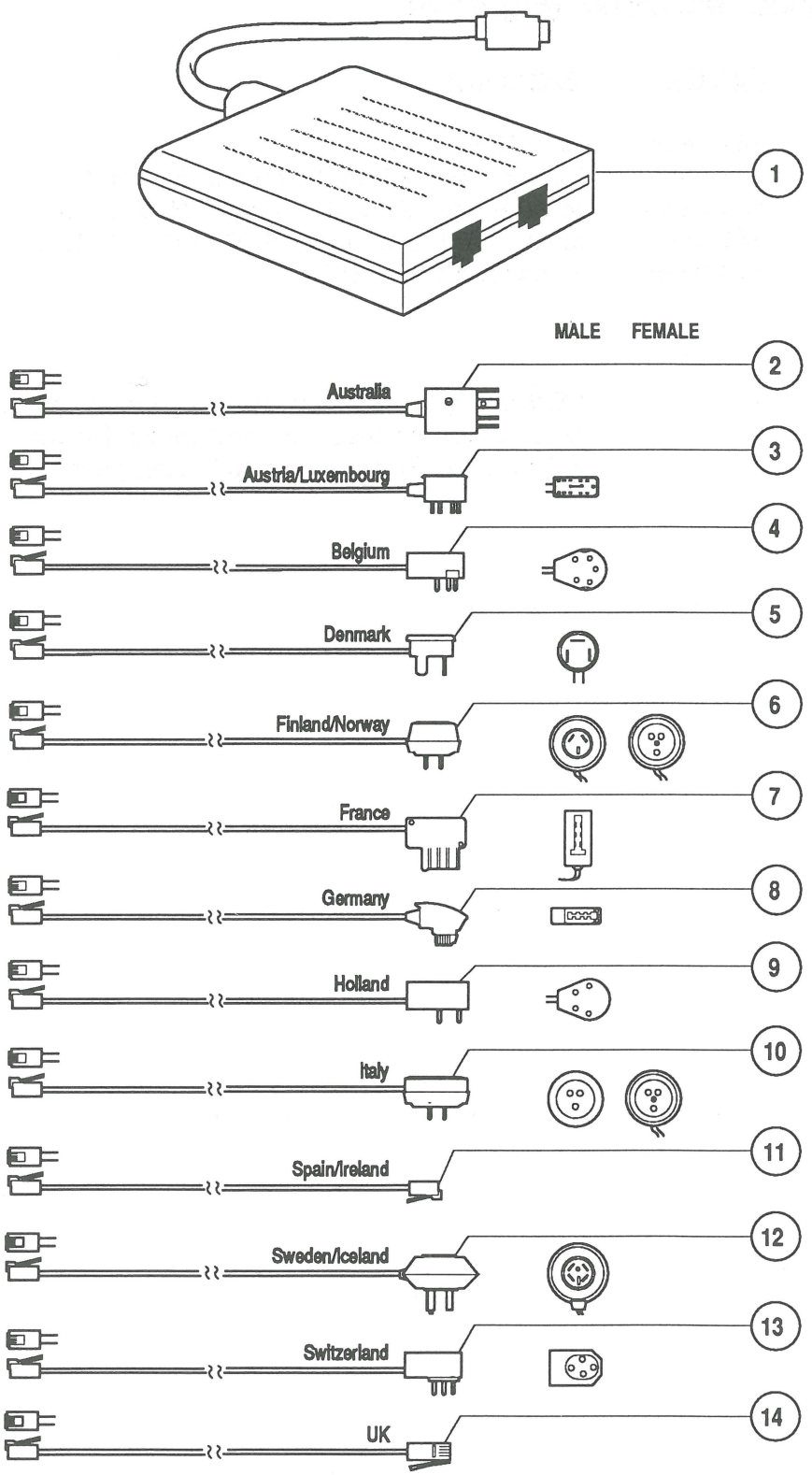

1
MALE
FEMALE
2
Australia
3
Austria/Luxembourg
4
Belgium
5
Denmark
6
Finland/Norway
7
France
8
Germany
9
Holland
10
Italy
11
Spain/Ireland
12
Sweden/Iceland
13
Switzerland
14
UK

FIGURE 9

❑ DATA ACCESS ARANGEMENTS (DAAs) AND CABLES (Figure 9)

Item	Part No.	Description
1	AU077-0235	DAA, Austria, International XP 2400
	FN077-0235	DAA, Belgium, International XP 2400
	DK077-0235	DAA, Denmark, International XP 2400
	K077-0235	DAA, Finland, International XP 2400
	F077-0235	DAA, France, International XP 2400
	D077-0235	DAA, Germany, International XP 2400
	N077-0235	DAA, Holland, International XP 2400
	ER077-0235	DAA, Ireland, International XP 2400
	T077-0235	DAA, Italy, International XP 2400
	H077-0235	DAA, Norway, International XP 2400
	Y077-0235	DAA, Spain, International XP 2400
	S077-0235	DAA, Sweden, International XP 2400
	SD077-0235	DAA, Switzerland, International XP 2400
	B077-0235	DAA, United Kingdom, International XP 2400
2	X076-8369	Cable, Australia
3	AU076-8369	Cable, Austria/Luxembourg
4	FN076-8369	Cable, Belgium
5	DK076-8369	Cable, Denmark
6	H076-8369	Cable, Finland/Norway
7	F076-8369	Cable, France
8	D076-8369	Cable, Germany
9	N076-8369	Cable, Holland
10	T076-8369	Cable, Italy
11	Y076-8369	Cable, Spain
	ER076-8369	Cable, Ireland
12	S076-8369	Cable, Sweden/Iceland
13	SD076-8369	Cable, Switzerland
14	B076-8369	Cable, United Kingdom

Note: The above items are not available in the U.S.

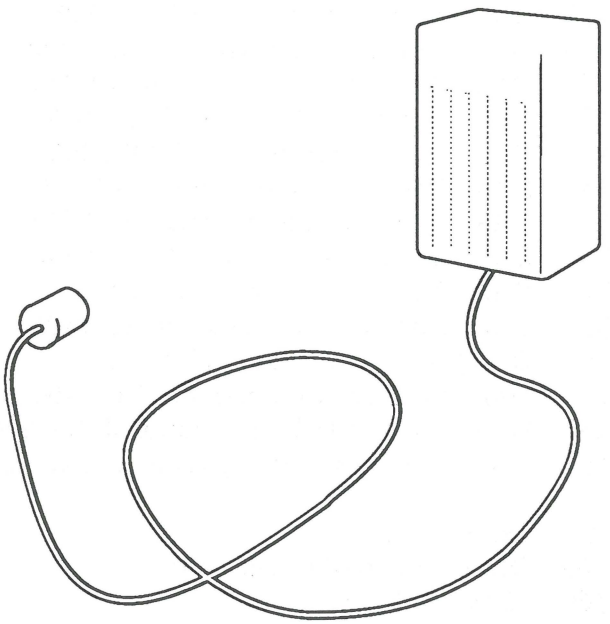


FIGURE 10

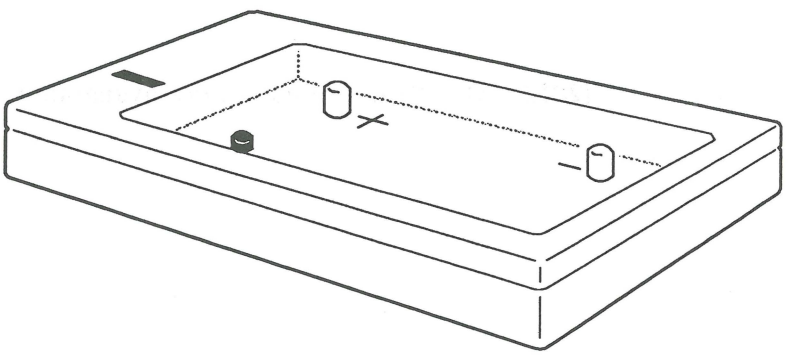


FIGURE 11

❑ POWER ADAPTER (Figure 10)

Item	Part No.	Description
–	699-0505	Power Adapter/Charger
	B699-0505	Power Adapter/Charger, UK
	JA699-0505	Power Adapter/Charger, Japan
	Z699-0505	Power Adapter/Charger, Europe, 220 volt
	X699-0505	Power Adapter/Charger, Australia

❑ BATTERY RECHARGER (Figure 11)

Item	Part No.	Description
–	630-6386	Battery Recharger

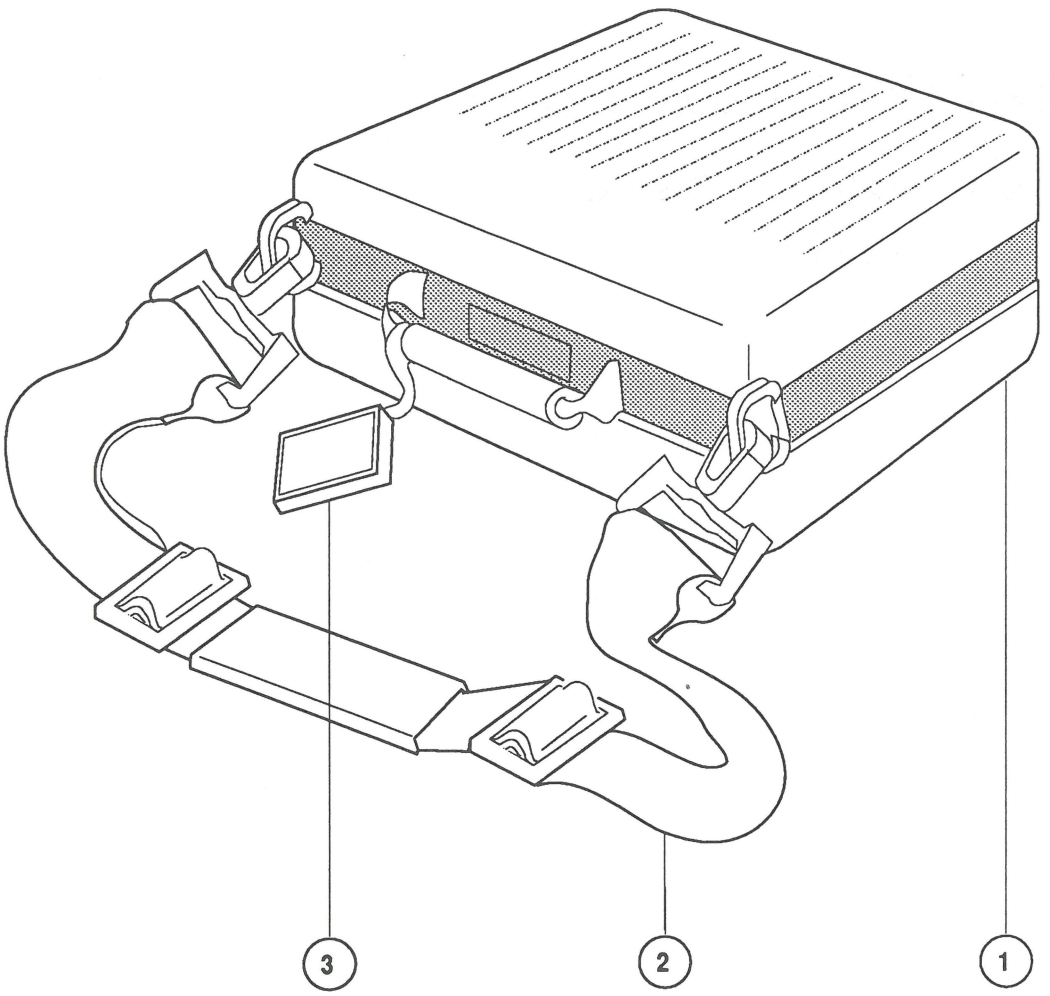


FIGURE 12

❑ CARRYING CASE (Figure 12)

Item	Part No.	Description
1	630-5574	Carrying Case
2	699-0508	Carrying Case Strap
3	699-0142	Luggage Tag
	699-0155	Luggage Tag

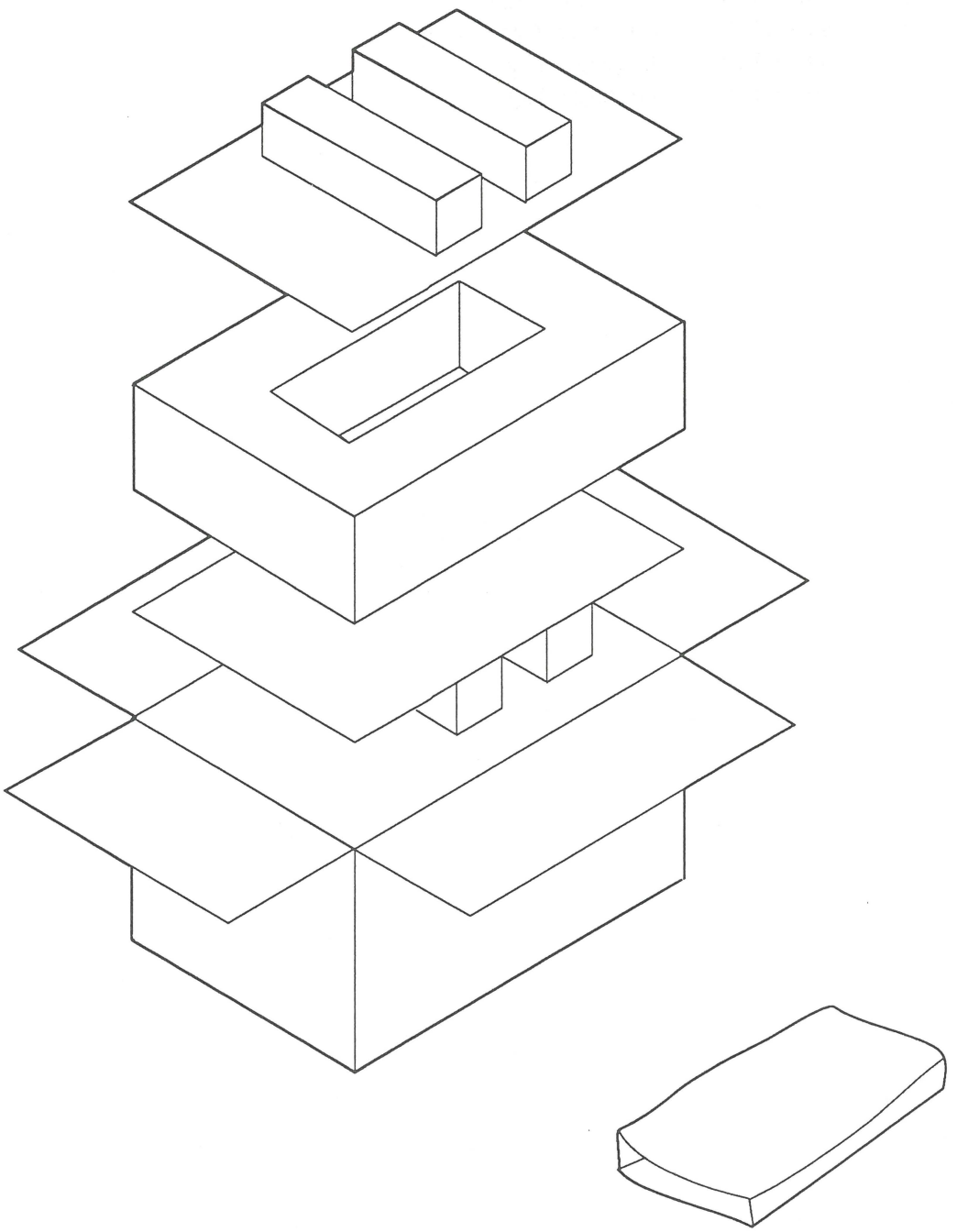


FIGURE 13

❑ REQUIRED SERVICE PACKAGING (Figure 13)

Item	Part No.	Description
–	602-0210	Packaging, 800K/FDHD SuperDrive
	805-5050	Shipping Fixture, FDHD SuperDrive Mechanism
	602-0208	Packaging, Battery (6 V)

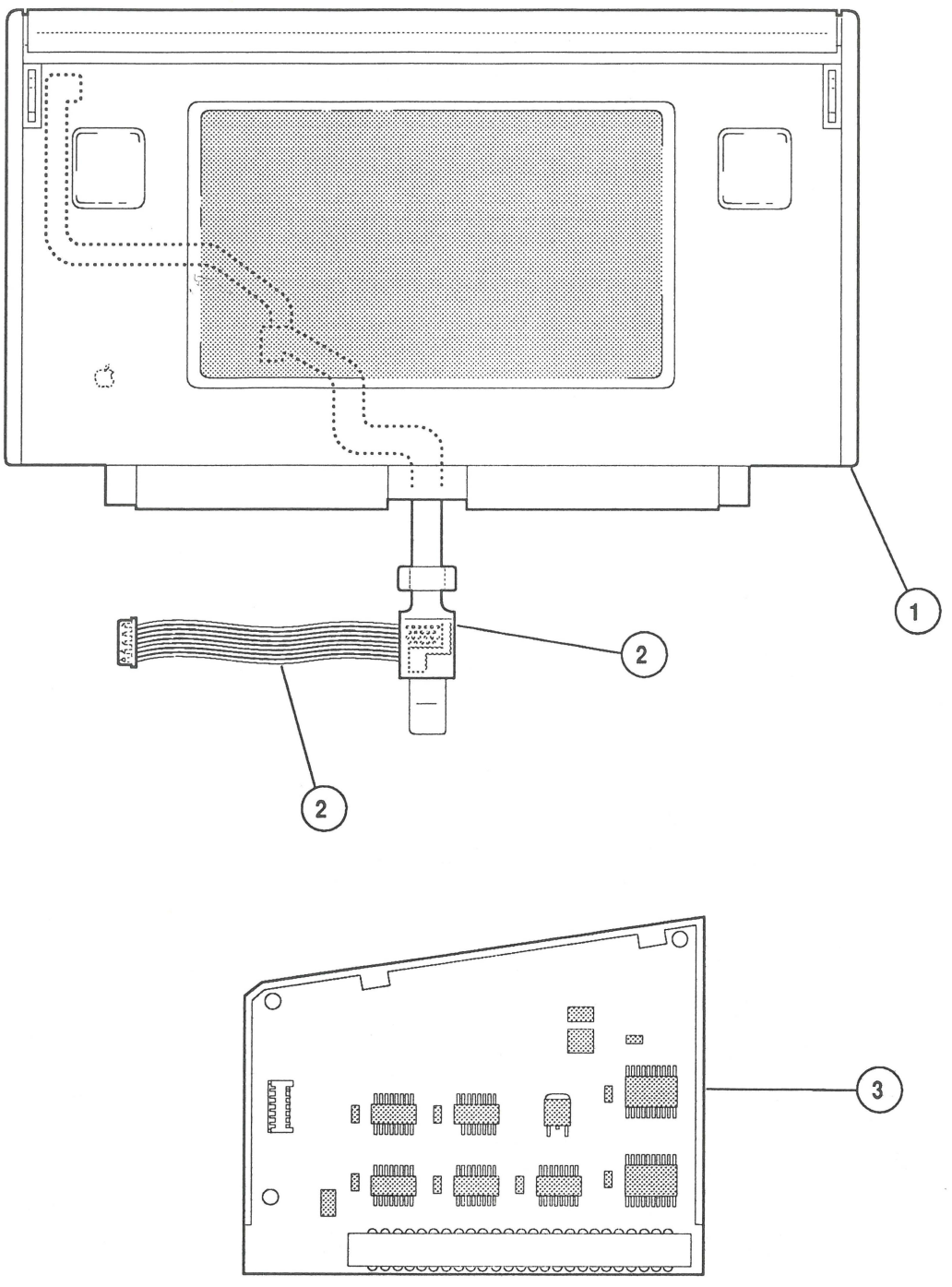


FIGURE 14

❑ BACKLIT DISPLAY UPGRADE (Figure 14)

Item	Part No.	Description
1	661-0647	Backlit LCD Display
2	630-6387	Display Cable, Backlit Upgrade
3	661-0648	ROM Card, Backlit Upgrade